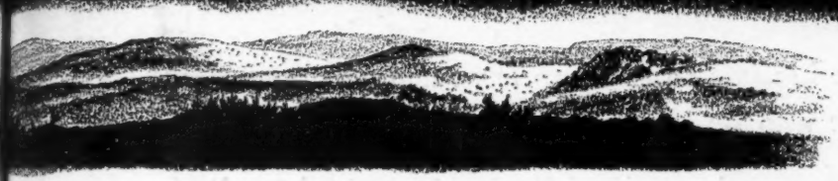
WATER WORKS & SEWERAGE

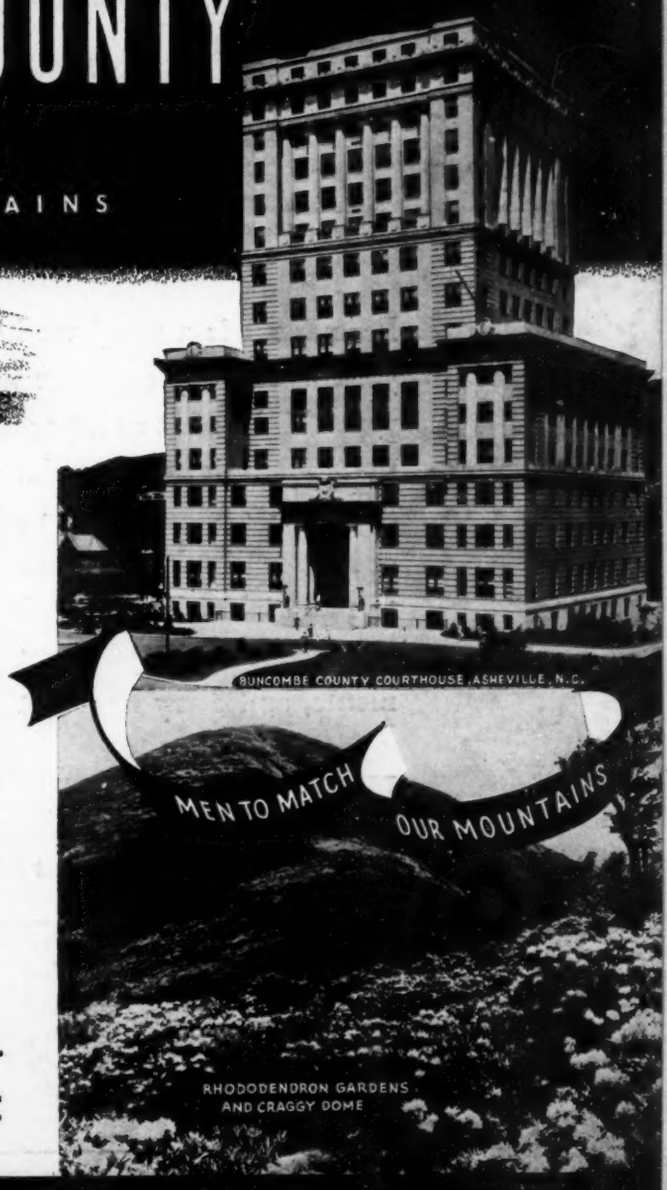
GILLETTE ABP ABC PUBLICATION

EDITOR

NOVEMBER, 1937
VOLUME 84, No. 11

In BUNCOMBE COUNTY
NORTH CAROLINA
IN THE GREAT SMOKY MOUNTAINS





Located in the Western part of North Carolina, Buncombe County, the resort center "In The Land of The Sky," is 2,250 feet above sea level. The City of Asheville is the County seat. One of the unique and interesting facts about Buncombe County is that it is the *only* county in the United States having a water and sewage system.

The Buncombe County Water Department consists of six water and sewer districts, namely, Swannanoa, South Buncombe, Hazel, Venable, Beaverdam and Caney Valley. These districts were established between 1925 and 1927. The Department has five equalizing reservoirs, three pumping stations, water and sewer lines in sizes from 4" to 10" pipe of approximately 405 miles in length, and 474 fire hydrants for fire protection in the rural districts. Water for the County is supplied from intakes located at the foot of Mt. Mitchell and Craggy Mountains. It is considered the purest in the Carolinas and can be used in automobile batteries without being distilled.

The water and sewer districts of Buncombe County have been largely responsible for the building up of the County. Pittsburgh Water Meters have been installed since the organization of the Water Department, and there are now some 1800 of these meters in the rural districts. Mr. J. C. Vance, Superintendent of the Water Department of Buncombe County extends a cordial invitation to visit him to learn more about the operation and maintenance of this unique department.

PITTSBURGH EQUITABLE METER CO.
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PITTSBURGH WATER METERS

Installation of U. S. Flexible Joint Cast Iron Pipe for sewer at Freeport, L. I.

Permanent is a word we hesitate to apply to any man-made material, yet the sanitary engineer who builds a pressure sewer with cast iron pipe thinks of it as a permanent structure. He has reason to. For the first authenticated installation of cast iron pipe for a community water supply is still in service after 270 years. A cast iron conduit is not only long-lived but efficient because it is infiltration-proof, both as to material and joints. We supply either pit cast or Super-de Lavaud *chill-free* centrifugally cast pipe with joints and fittings for all requirements, and carry stocks at 15 shipping points.

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U. S. CAST IRON PIPE

for sewers and sewage treatment plants

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Lime - Soda ash -
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ILLUSTRATED on this page, a few Airveyor installations handling lime, soda ash, alum, ferric sulphate, the most efficient and economical system for unloading and conveying your granular materials. This system offers many advantages and economies, some of which are:

- Savings by purchasing in bulk
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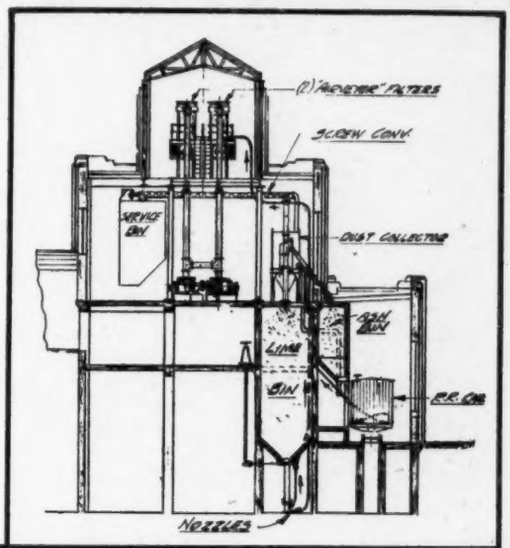
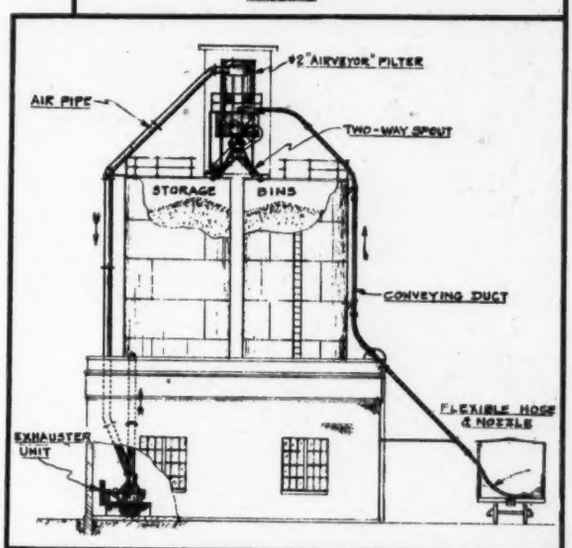
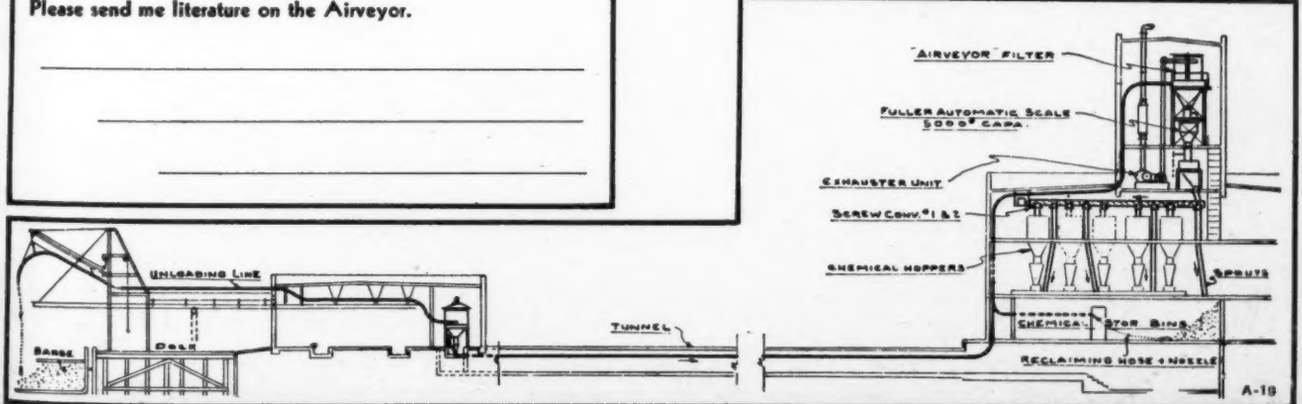
Can't we interest you in this modern method of conveying? Fill in the coupon below and we will gladly send you detailed information.







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ROTARY AIR COMPRESSORS AND VACUUM PUMPS · · · AUTOMATIC BATCH WEIGHERS · · · BIN SIGNALS

WATER WORKS AND SEWERAGE, November, 1937, Volume 84, Number 11. Published monthly at 400 West Madison Street, Chicago, Ill., by the Gillette Publishing Company. Per copy, 25c. Subscription rate, $2.00 per year; Canadian and Foreign, $3.00 per year. Copyright, 1937. Entered as Second Class Matter, June 2, 1931, at the Post Office at Chicago, Ill., under the Act of March 3, 1879.

There MAY BE TROUBLE AHEAD

TROPICAL STORMS racing up the coast line are the forerunners of winds that denude the trees, blowing dead leaves into streams, reservoirs, etc.

To the Water Works personnel this means only another source of taste and odors.

The alert Plant Operator is prepared with a larger supply of Activated Carbon, ready to step up the dose to take care of the increased tastes and odors.

The Plant Operators have found that the furnishing of a palatable drinking water through the use of Activated Carbon so enhances the prestige of the Water Department, that it is now being used the year around.

The cost of furnishing palatable drinking water through the use of Activated Carbon is so negligible that no justification exists today for not furnishing a drinking water suitable "to the King's taste."

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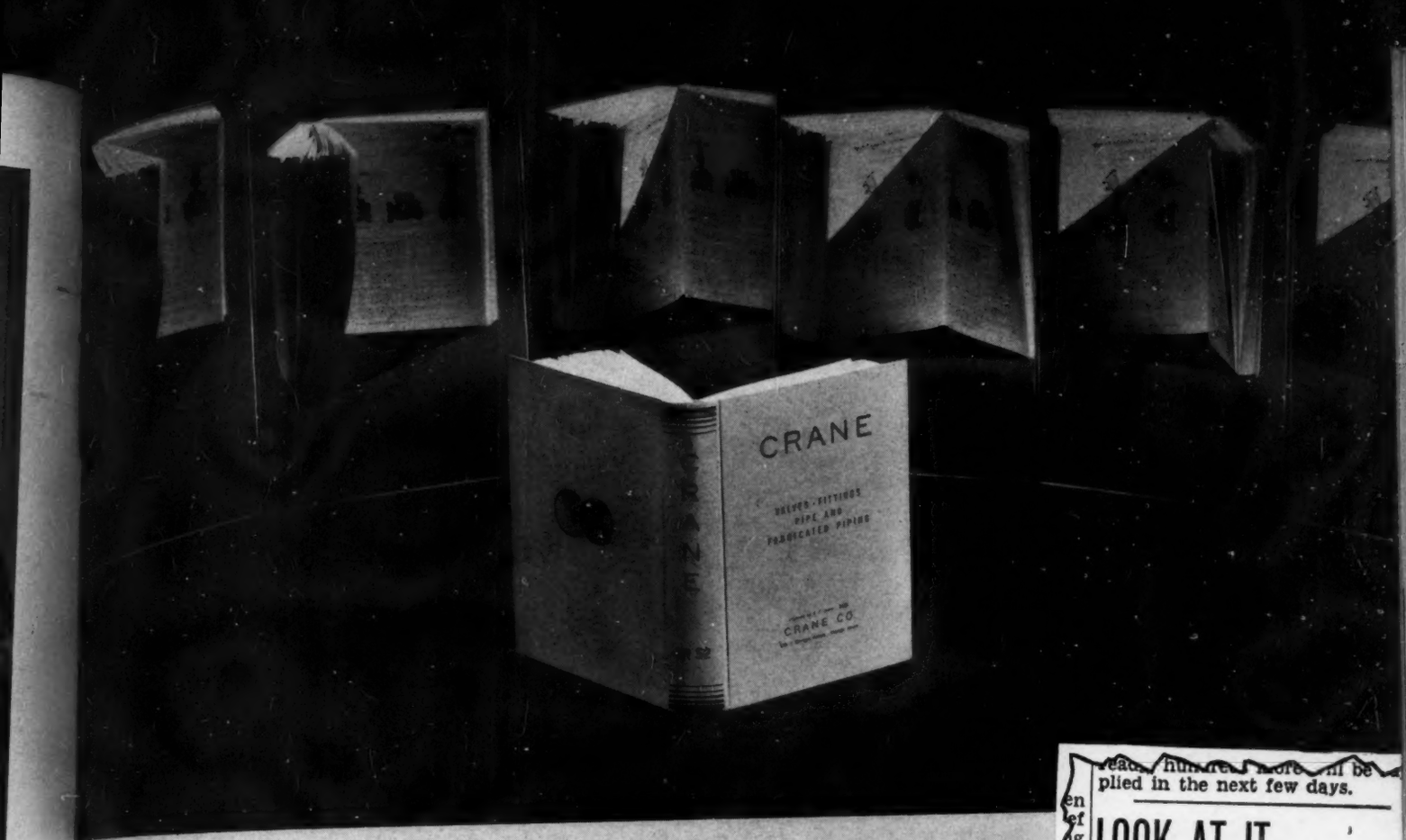

From every Angle

THIS CATALOG REFLECTS THE INFORMATION YOU NEED

Looked at from the angle of a catalog for industry the Crane No. 52 Catalog lists, describes, illustrates and prices more than 38,000 separate valve and fitting items covering practically every normal requirement of modern industry.

Looked at from the angle of the engineer this same book contains valuable information on all piping and control problems.

Looked at as a source of reference data you will find almost 100 solid pages of formulas, tables and engineering material.

Looked at from any angle, when you are using the Crane No. 52 Catalog, you are using the largest, most complete encyclopedia of valves, fittings and piping equipment in the world. The ease with which Crane can meet your requirements assures you just the right equipment you need for every service. CranEquip your plant throughout for maximum satisfaction.

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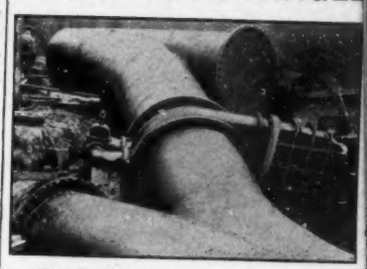
...plied in the next few days.

LOOK AT IT FROM THE WATERWORKS ANGLE



CHICAGO, ILL., Oct. 20—Looked at from the angle of the man responsible for a water or sewerage system, the Crane No. 52 Catalog is a source of practically invaluable information. There are sections and tables of fundamental data on piping problems that are readily accessible at all times.

From the data it is but a turn or two of the page to the CranEquipment which will do the job. And from the book it is generally only a short distance to the nearest Crane branch or distributor for the equipment itself. This proximity of Crane supplies is particularly valuable when emergency repairs are necessary.

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Both aeration and mixing accomplished simultaneously by common unit • Equipment cost from $300 to $500 per M.G.D. capacity • Power requirement normally less than 1.0 kw. per M.G.D. capacity.

OTHER OUTSTANDING ADVANTAGES

Avoidance of ice troubles • Flexibility • Elimination of extra pumping.

The use of Aloxite Brand Diffuser Plates or Tubes assures a long life of satisfactory service.

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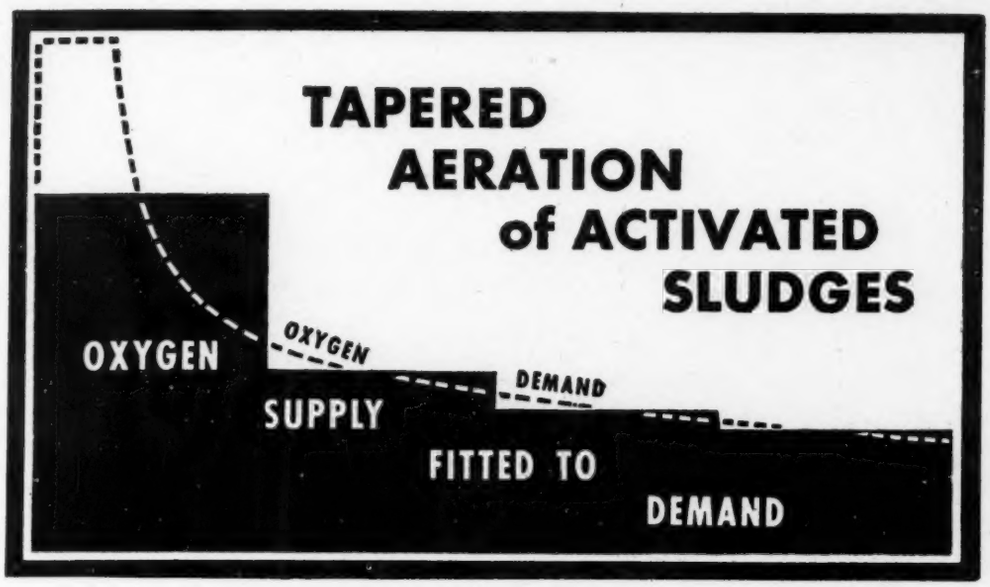

Tapered Aeration affords control of the Activated Sludge Process of sewage treatment to produce a consistently high degree of purification under widely varying conditions of sewage flow and strength.

This is effected by simple control of the rate of oxygen supply and return sludge to maintain the required maximum sludge activity.

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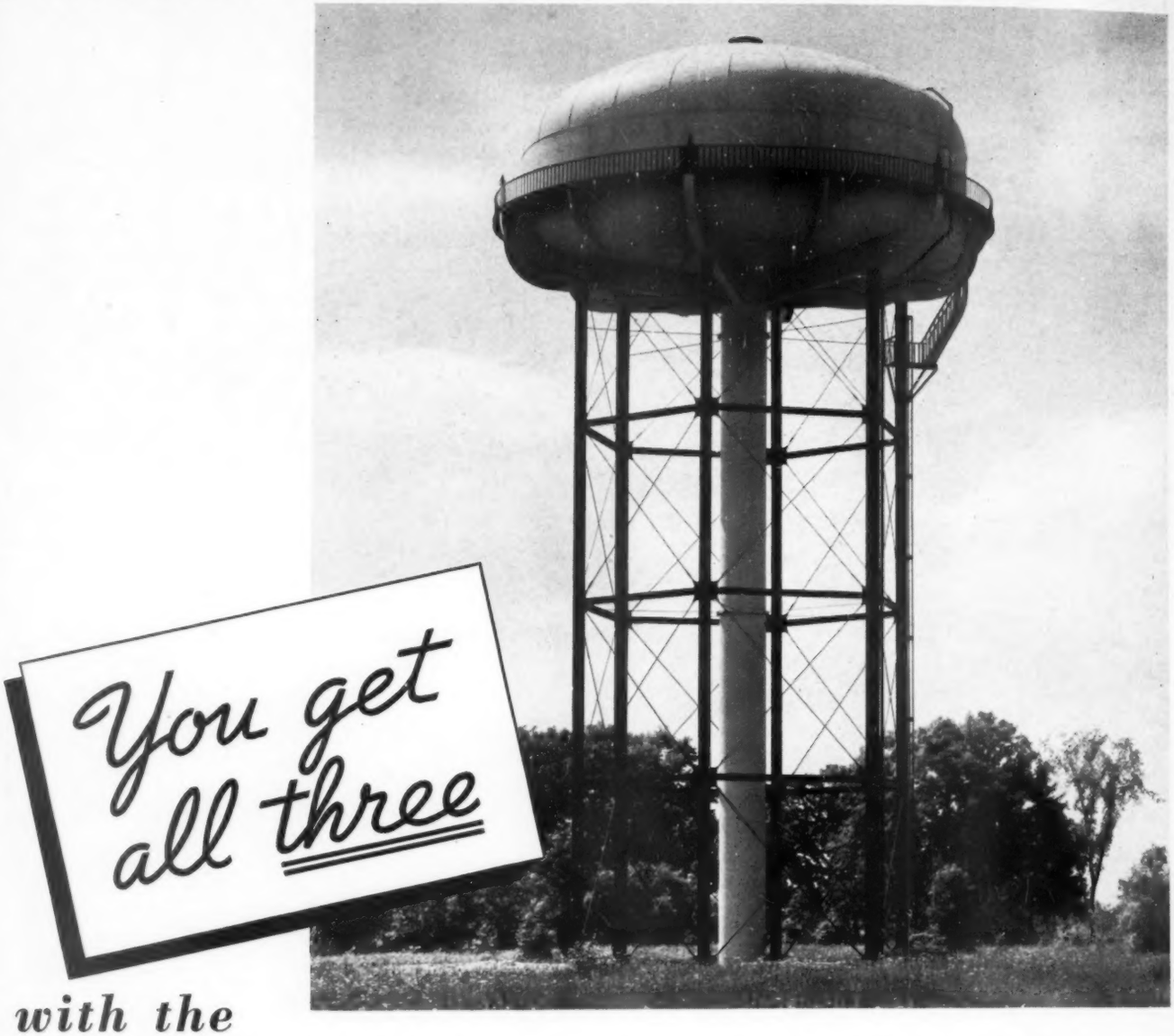

with the HORTON *RADIAL CONE BOTTOM* DESIGN

THE picture above shows a new 250,000-gal. Horton elevated tank installed recently in the Marysville, Michigan, waterworks system. It offers a good example of the pleasing results that can be obtained with the Horton *radial-cone bottom* design in a medium size tank.

The body of the tank and the riser are painted gray while the tower is black. And not only does it look modern, it is modern! The full capacity of the tank is available at a range of head between upper and lower levels of only 20 ft. The uniformity of pressure that results is valued by domestic and industrial consumers alike.

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BURTON W. GRAHAM
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To those not using Blackalum or Standard Activated Alum—

DO YOU KNOW— • "That in dollars and cents in plant operation these Alums produce the best water."

DO YOU KNOW— • "They are now used by the biggest names in water treatment practice."

DO YOU KNOW— • "They are used by the Government."

DO YOU KNOW— • "They are recommended by leading consulting engineers."

DO YOU KNOW— • "That we guarantee their performance."

Why not give them a trial at your plant because it is being said—

"YOU GET THE BEST COAGULANTS FROM ACTIVATED ALUM CORP."

DO NOT SIGN YOUR NEXT YEAR'S ALUM CONTRACT UNTIL YOU HAVE TESTED OUR ALUMS AND RECEIVED OUR PRICE QUOTATIONS.

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Gentlemen: We would like to have laboratory samples of:

- ☐ Blackalum
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- ☐ Be placed on your mailing list

NAME .....
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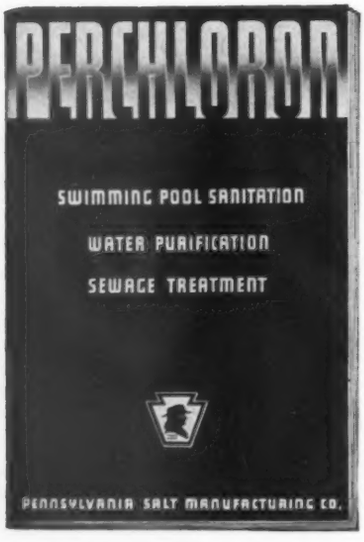
The kitchen shelves of any home show why you should have Perchloron



It would be hard to find any home that doesn't keep at least a small supply of canned vegetables and canned fruit on hand... preparation for that time when food is needed but all the stores are closed.

In this homely illustration you see the reason why so many water purification plants make a policy of keeping on hand a supply of Perchloron, for use in emergencies. They know that floods, storms, and accidents beyond human control can sometimes tie up transportation temporarily. Normal supplies of chlorine may not be instantly available. That is when a supply of Perchloron in reserve can well repay your foresight.

Perchloron has an available chlorine content of more than 70%. Dissolves readily in water. Concentrated, stable, and perfectly uniform. Packed 12 handy-sized cans to the case — no return containers to bother with.

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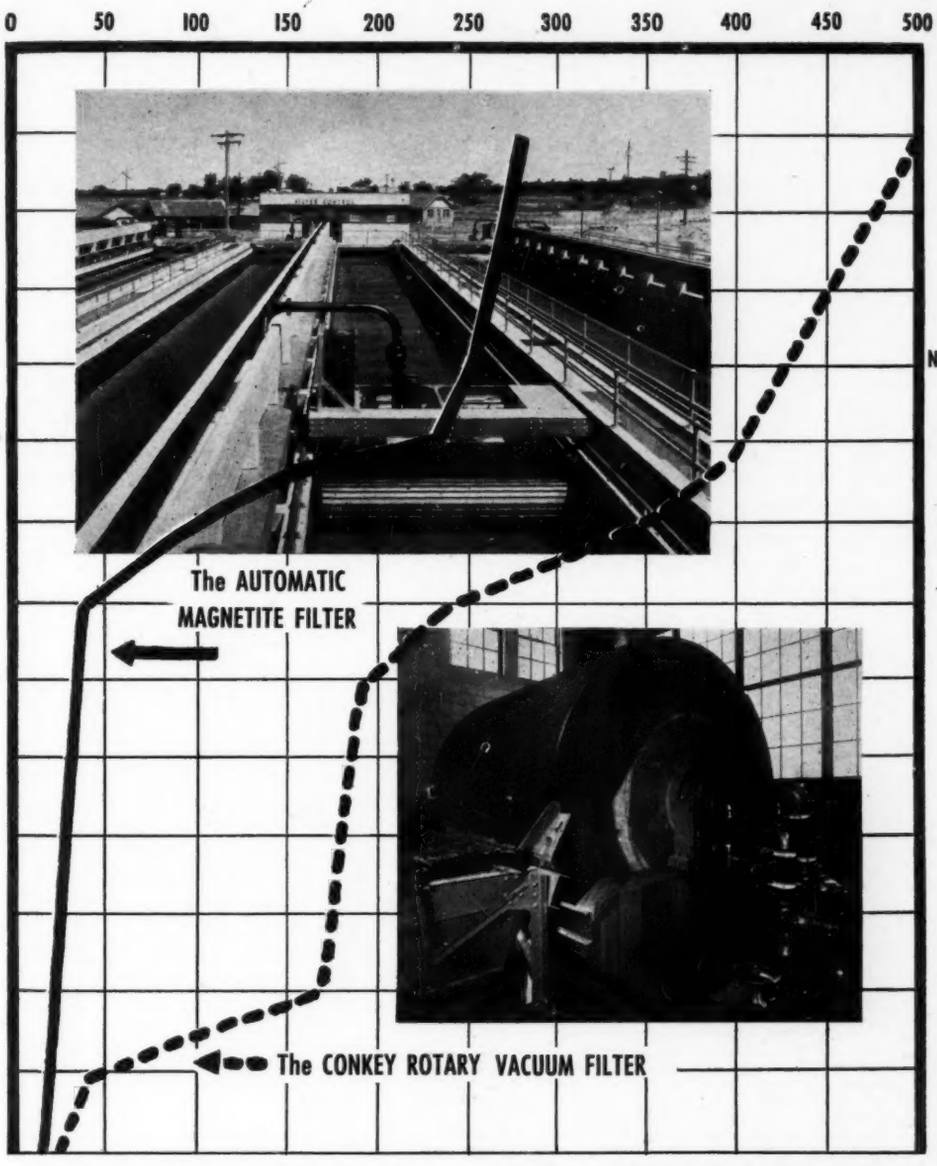

REMOVES SOLIDS — DEWATERS SLUDGES

THIS Installation record of the past 5 years is ample proof of the wide acceptance of Automatic Magnetite Filters for removing putrescible suspended solids and of Conkey Rotary Vacuum Filters for dewatering sludges.

Effectiveness and low cost are outstanding features in the performance of these filters in any type of sewage disposal plant. They provide new tools for engineers to solve sanitary problems at outstanding Modern Sewage Treatment Plants.

Literature and full data will be gladly sent on request.

ELGIN, ILLINOIS, TELLS HOW THE REX TRITURATOR HANDLES IT IF *IT* IS SEWAGE SCREENINGS

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SANITARY DISTRICT OF ELGIN
ELGIN, ILLINOIS

July 8, 1937

Mr. W. B. Marshall,
Manager, Sanitation Equipment Division,
Chain Belt Company,
Milwaukee, Wisconsin.

Dear Mr. Marshall:

You may be interested to know that the two Rex Triturators installed in our Pumping Stations Nos. 1 and 2 are shredding screenings removed from our cage screens very successfully. Especially is this true at Pumping Station No. 2, where the discharge from the Elgin National Watch Company has only a run of approximately 200 feet and passes immediately through the screen, leaving little chance for rags and other debris to disintegrate or pull apart.

The installation of our Rex Triturator has removed a very disagreeable part of the operator's duties. Previously, we trucked through the city streets all screenings removed at the Pumping Stations and disposed of them at the treatment plant. This, as you know, was not a very sanitary or agreeable task. But now the public is no longer aware that we have screenings because the cage screens are lifted, cleaned, and the screenings put through the Triturators and then discharged back into the sewage and conveyed to the treatment plant.

As you will recall, all sewage pumped at Station No. 2 is again pumped at Station No. 1 and discharged into the treatment plant. Therefore, all screenings that are Triturated at Station No. 2 must pass through the screens at Station No. 1. I am glad to say that they are so finely shredded that we have never noticed any of the shredded screenings on the screens at Station No. 1.

I have been taking particular notice of our primary settling tanks after being informed by a number of persons that the screenings would float on the tank surface. To date, I have not noticed any screenings floating on the surface of either the Chain Belt Primary Tank or the Imhoff Tanks.

Believing that you might be interested in the above information and thanking you for your personal interest in helping us accomplish the very satisfactory results obtained, I am

Yours very truly,

Sanitary District of Elgin

District Superintendent

EES/ES

● Elgin Sanitary District, after thoroughly investigating other methods and equipment, chose Rex Triturators. You, too, can use to advantage this modern, economical method of screenings disposal. Send for further information today. Ask for your copy of the Rex Triturator Catalog. Address the Sanitation Equipment Division,

CHAIN BELT COMPANY
1610 W. Bruce Street
Milwaukee, Wisconsin
●

Rex Triturator, Pumping Station #2, Elgin, Illinois

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Sanitation Equipment

COLUMBIA

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COLUMBIA LIQUID CHLORINE is produced in our plant at Barberton, Ohio, conveniently located on four railroads and is shipped in single and multiple tank cars of latest design and in 100 and 150 lbs. cylinders.

THE COLUMBIA ALKALI CORPORATION

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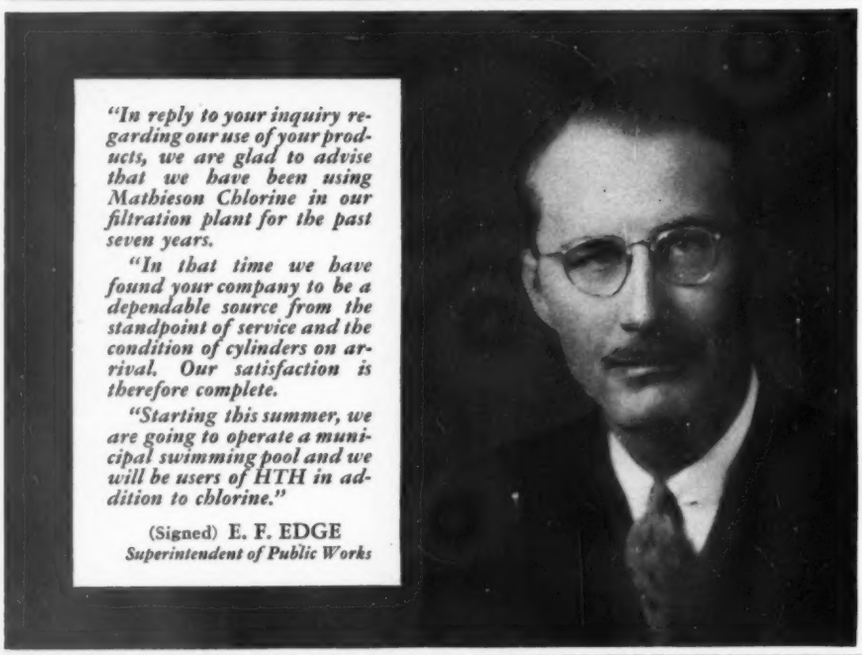
GETS DEPENDABLE SERVICE *FROM MATHIESON CHLORINE FOR 7 YEARS*



"In reply to your inquiry regarding our use of your products, we are glad to advise that we have been using Mathieson Chlorine in our filtration plant for the past seven years.

"In that time we have found your company to be a dependable source from the standpoint of service and the condition of cylinders on arrival. Our satisfaction is therefore complete.

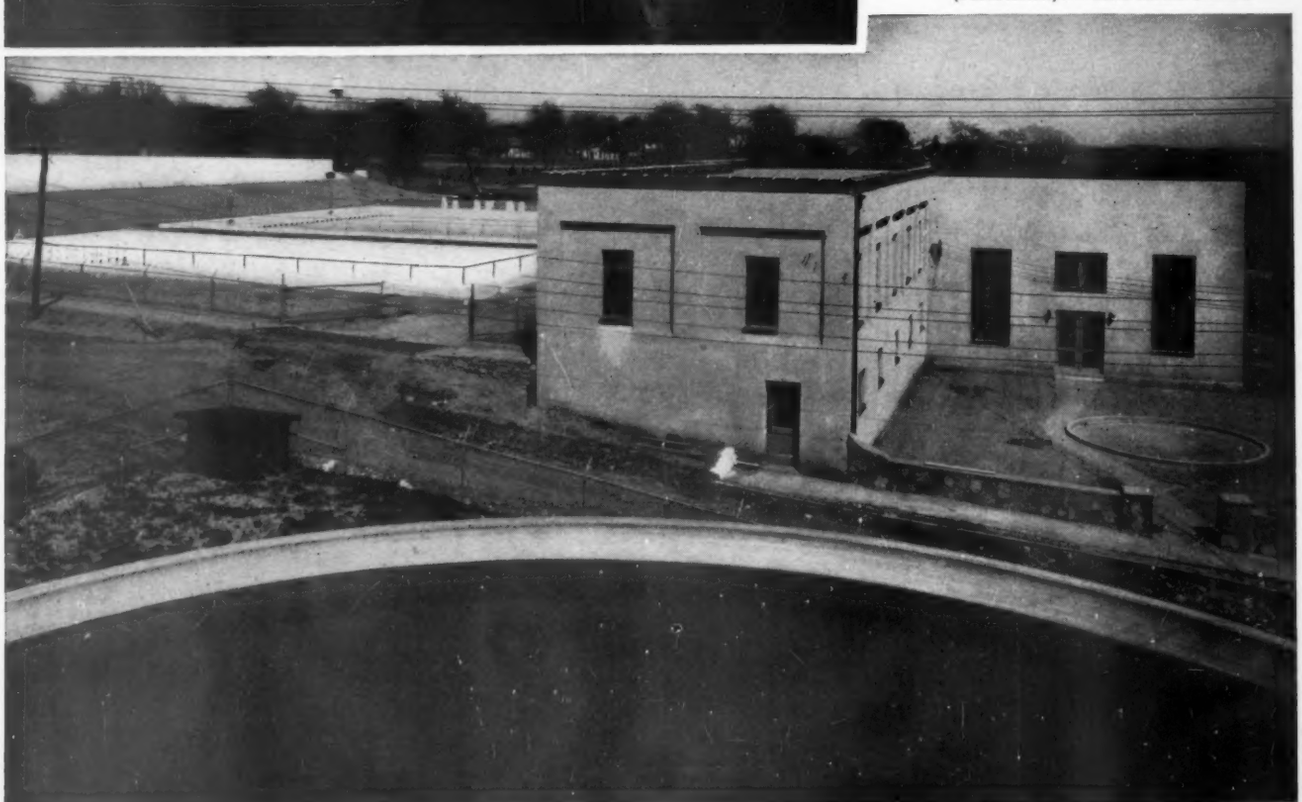
"Starting this summer, we are going to operate a municipal swimming pool and we will be users of HTH in addition to chlorine."

(Signed) E. F. EDGE
Superintendent of Public Works

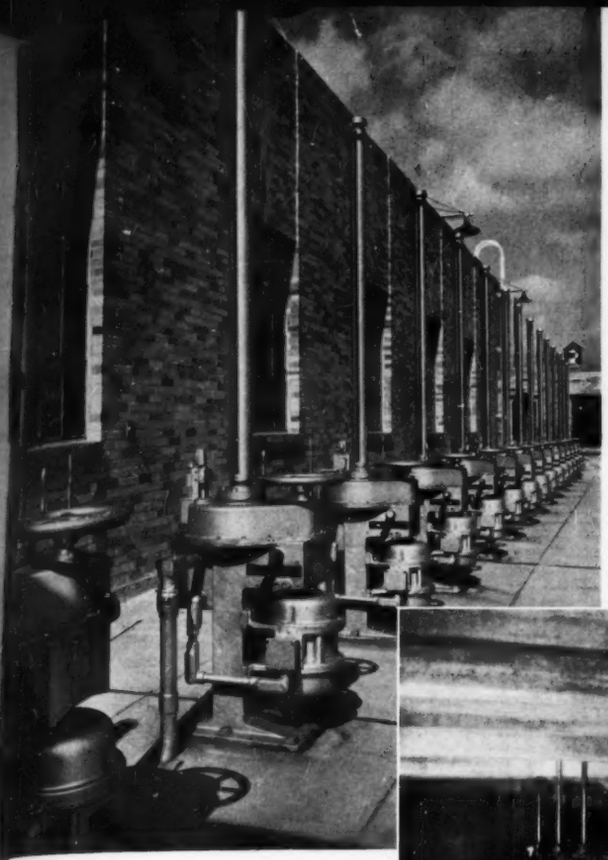
EVER since the pioneer days of shipping liquid chlorine, dependability has been the keynote of Mathieson's service to chlorine users. No effort is spared in supplying a pure product, in trouble-free container equipment, delivered to you at the time specified. That is why men like Mr. Edge, upon whom rests the responsibility of insuring a safe water supply for their communities, continue to contract for Mathieson Liquid Chlorine year after year.

The* MATHIESON ALKALI WORKS *(Inc.)
60 East 42nd Street **New York, N. Y.**

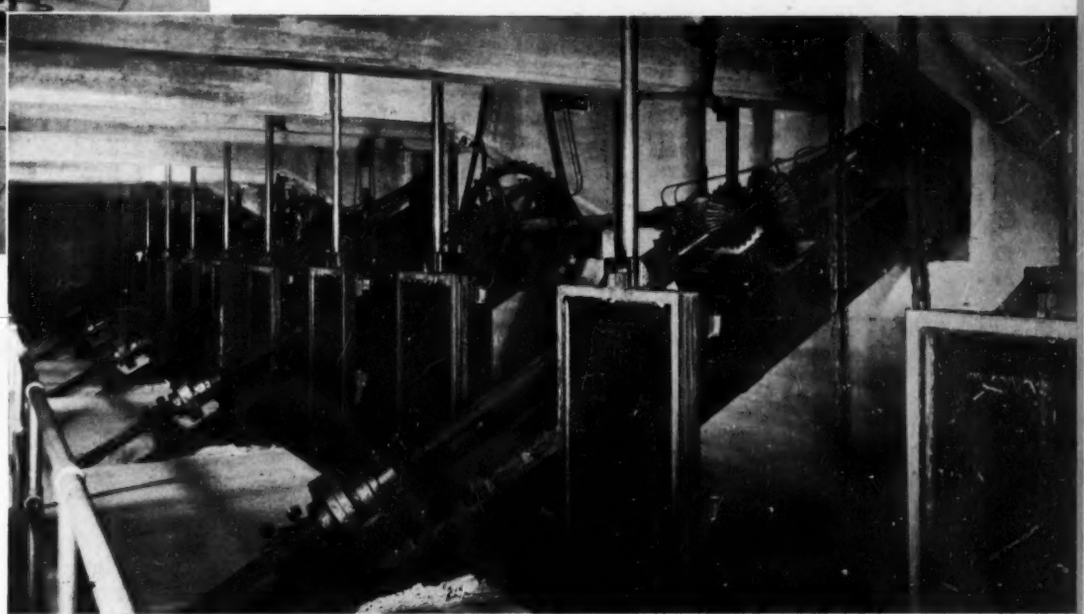
Soda Ash . . . Liquid Chlorine . . . Bicarbonate of Soda . . . HTH and HTH-15 . . . Caustic Soda . . . Bleaching Powder . . . Ammonia, Anhydrous and Aqua . . . PH-Plus (Fused Alkali) . . . Solid Carbon Dioxide.



View of filtration Plant at Shawnee and (above) E. F. Edge, Superintendent of Public Works, City of Shawnee, Oklahoma.



24 Mueller Sluice Gates and Electrically Operated Floor Stands in a $3,600,000 Plant.



Controlling 130 m.g. Daily at

THE NATION'S CAPITAL

All the sewage in the District of Columbia will eventually flow through this new $3,600,000 plant and it is all controlled by Mueller-Columbian Electrically Operated Floor Stands and Sluice Gates. Washington engineers had the choice of the nation's best equipment to select from, but naturally they selected MUELLER-COLUMBIAN because they met all the requirements of reliable, smooth, trouble-free operation and high resistance to corrosion. They also knew that the Mueller practice of building precisely to gauges and templates meant accuracy and ease of installation.

Whatever your water control problems may be, it will pay you to get in touch with MUELLER and receive the benefit of their years of experience. Data on products, service and costs will be cheerfully submitted. Write for descriptive literature today.

MUELLER CO. CHATTANOOGA, TENN

REILLY

PIPE ENAMEL AND PRIMER

Inside and Out.....GIVE PERMANENT PROTECTION

REILLY Pipe Enamel and Primer give complete and lasting protection to both the exterior and interior surfaces of water lines . . . The exterior surface is protected against electrolysis and corrosion due to soil acids or alkalies, soil stress, etc. The interior surface is protected against tuberculation, incrustation and bacterial growth. Reilly Pipe Enamel lining for water lines assures full capacity flow indefinitely.

You can depend upon Reilly coatings to withstand extreme changes in temperature without sagging in intense heat or cracking in sub-zero weather.

Recommended specifications and complete information on any special protective coating problems will be promptly supplied on request.

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Executive Offices: Merchants Bank Building, Indianapolis, Indiana

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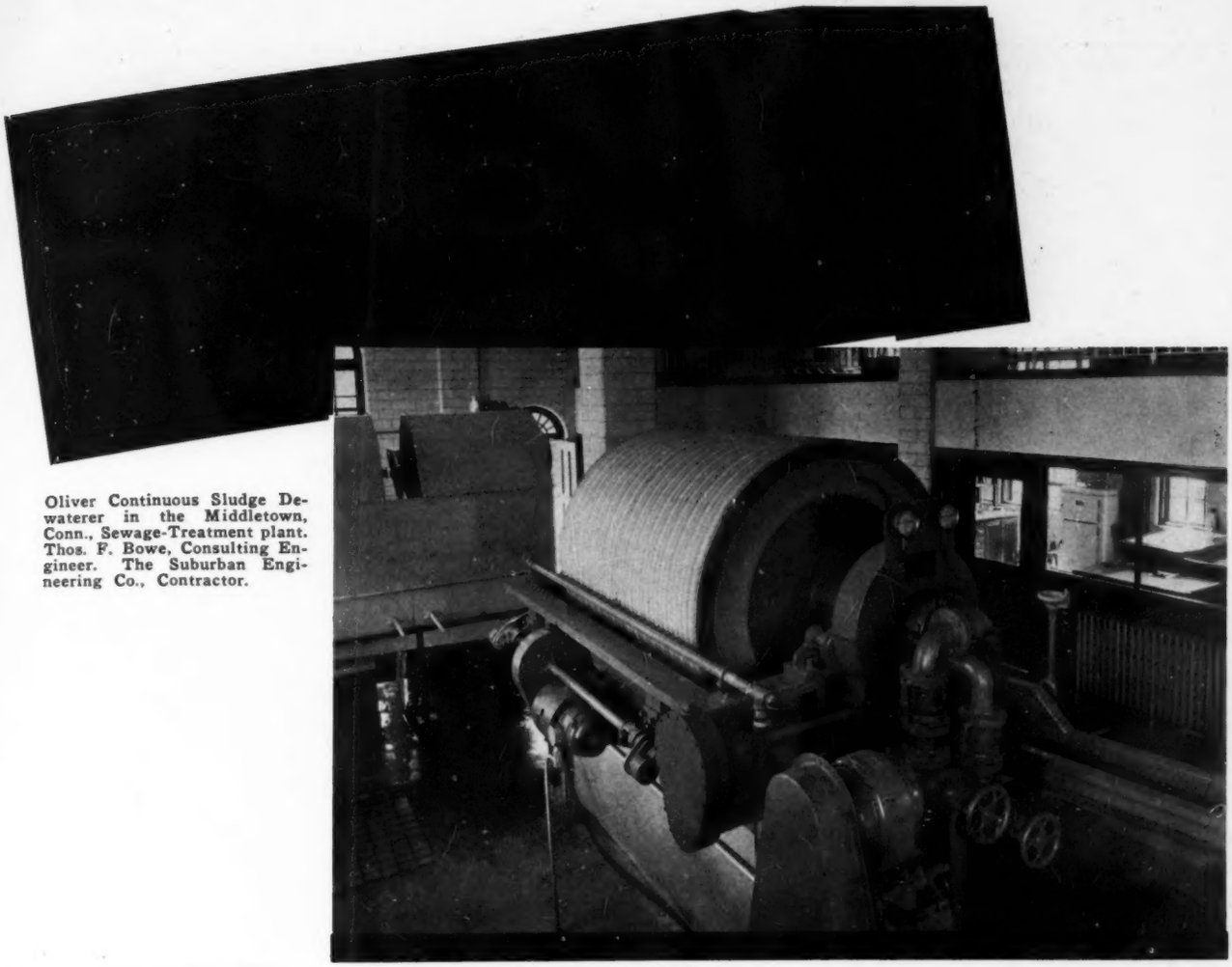
FIFTEEN PLANTS TO SERVE YOU

Reilly COAL TAR PRODUCTS



Oliver Continuous Sludge Dewaterer in the Middletown, Conn., Sewage-Treatment plant. Thos. F. Bowe, Consulting Engineer. The Suburban Engineering Co., Contractor.

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WATER WORKS & SEWERAGE

E. S. GILLETTE, Publisher

L. H. ENSLOW, Editor

ARTICLES AND AUTHORS Scheduled for Future Issues

"Running Down Unaccounted for Water"—is a Sherlock Holmes and Dr. Watson story from D. D. Gross, Chief Engr., of Denver's Water Commission. Depicted is Denver's unique and eminently practical method of getting on the trail of major main leaks and water stealing. WATER WORKS & SEWERAGE readers will learn how routine scheduled measurements, and record keeping of minimum hourly flows through branch and lateral sewers, are put to use by "Denver's Water Waste Detective Bureau" in discovering and tracing down hidden main leaks or important water stealing. It's an intriguing and worth following story that comes from sleuth "Sherlock Holmes" Gross, "A.W.W.D."—which written out means Ace Water Waste Detective. Watch for it!

"Sewer Rental"—is the topic of an article from Robert A. Allton, Chief Engineer of Sewerage, Columbus, Ohio. In financing modern sewage treatment, the sewer-rental charge has come to be accepted as the most logical, equitable and certain method of securing self-supporting sewage disposal, adequate operator salaries and maintenance and operating funds; importantly, less political interference. Ohio has gone far in showing the practicability of this scheme of operating sewerage systems as a public utilities. Most of its cities are now operating on the sewer-rental basis of financing sewage treatment, and Mr. Allton will reveal the results of a study of sewer-rental ordinances and methods in use. From this, a plan for Columbus has been drawn, looking to incorporation of the most practical elements, with maximum simplification, and certain yield of sufficient revenue to properly operate and maintain the revamped Columbus system and new Sewage Treatment Plant,—designed, built, and to be operated, under the author's supervision.

In a later article Mr. Allton will describe the many unique and worth telling about design and operating features of the Columbus plant. This article is to be brim full of new ideas and new equipment in sewage treatment.

"The Human Element of Public Relations"—is discussed by an eminently "human" and thoroughly practical manager of a water utility serving a small city. The author—Mentor Hetzer, Supt.-Manager of the Moundsville, W. Va. Water Co., (American Water Works & Elec. Co. subsidiary)—is already well known to many of our readers. In stressing the high importance of a friendly public, E. F. Dugger, President of A.W.W.A., has been spreading the Gospel that the greatest potentialities of municipal water works operator appreciation, advancement, and security, lies in the hands of the water department manager and employee. Water company managers recognize this truth more than ever before, and what Mr. Hetzer has to say comes from his inner soul. The fundamentals are covered in his four precepts. They are as meaningful to the municipal operator in the smallest community, as to the president of the largest chain system. The foundation of water operator advancement lies on "Good Public Relations," just another way of saying—in the friendship and support of a public, intolerant of political interference and of inadequate income for services usually too little appreciated. Read Mentor Hetzer's story, and have every water works employee learn its context by heart.

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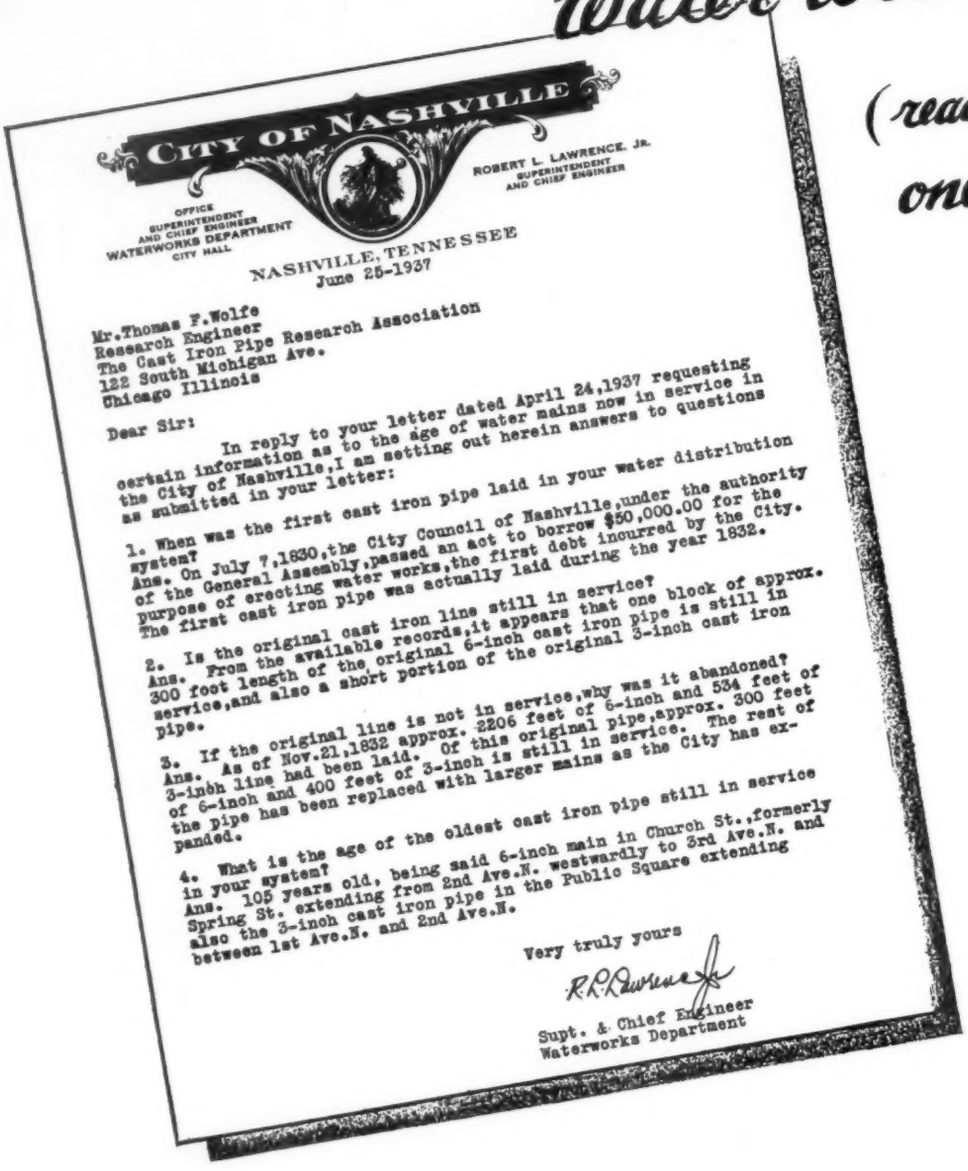
A letter of interest to water works men

(reading time one minute)



CITY OF NASHVILLE

ROBERT L. LAWRENCE, JR.
SUPERINTENDENT
AND CHIEF ENGINEER

OFFICE
SUPERINTENDENT
AND CHIEF ENGINEER
WATERWORKS DEPARTMENT
CITY HALL

NASHVILLE, TENNESSEE
June 25-1937

Mr.Thomas F.Wolfe
Research Engineer
The Cast Iron Pipe Research Association
122 South Michigan Ave.
Chicago Illinois

Dear Sir:

In reply to your letter dated April 24,1937 requesting certain information as to the age of water mains now in service in the City of Nashville,I am setting out herein answers to questions as submitted in your letter:

1. When was the first cast iron pipe laid in your water distribution system?
Ans. On July 7,1830,the City Council of Nashville,under the authority of the General Assembly,passed an act to borrow $50,000.00 for the purpose of erecting water works,the first debt incurred by the City. The first cast iron pipe was actually laid during the year 1832.

2. Is the original cast iron line still in service?
Ans. From the available records,it appears that one block of approx. 300 foot length of the original 6-inch cast iron pipe is still in service,and also a short portion of the original 3-inch cast iron pipe.

3. If the original line is not in service,why was it abandoned?
Ans. As of Nov.21,1832 approx. 2206 feet of 6-inch and 534 feet of 3-inch line had been laid. Of this original pipe,approx. 300 feet of 6-inch and 400 feet of 3-inch is still in service. The rest of the pipe has been replaced with larger mains as the City has expanded.

4. What is the age of the oldest cast iron pipe still in service in your system?
Ans. 105 years old, being said 6-inch main in Church St.,formerly Spring St. extending from 2nd Ave.N. westwardly to 3rd Ave.N. and also the 3-inch cast iron pipe in the Public Square extending between 1st Ave.N. and 2nd Ave.N.

Very truly yours
R.L.Lawrence Jr.
Supt. & Chief Engineer
Waterworks Department

We have asked Nashville and 211 other cities whether *original cast iron mains* in their water distribution systems were still in service. Mr. Lawrence's letter (reproduced by permission) is typical of 203 others out of 212—96 percent—whose answers were—*yes.* Only a material with great *bursting* strength, *beam* strength, *crushing* strength, *impact* strength, and *effective corrosion resistance*—indispensable requirements of an underground water main—can render such enduring and economical service.

THE CAST IRON PIPE RESEARCH ASSOCIATION

Thomas F. Wolfe, Research Engineer, 1015 Peoples Gas Building, Chicago, Illinois

Water Works and Sewerage—November, 1937

WATER WORKS AND SEWERAGE
A GILLETTE PUBLICATION
VOL. 84 NOVEMBER, 1937 No. 11

THE BIRMINGHAM INDUSTRIAL WATER SUPPLY SYSTEM*

Some Design and Construction Features of the Supply and Distribution Mains

By A. CLINTON DECKER
*Sanitary Engr.,** Tenn. Coal, Iron and Ry. Co., Birmingham, Ala.*

The Author

THE principal units of the Birmingham Industrial Water Supply System are:

1. An impounding dam, approximately 195 ft. high and 1,100 ft. long at the crest. Behind it there will be formed a lake 7 miles long and containing 21 billion gallons of water. This dam is of rock fill and earth construction. The water seal is formed with closely compacted clay on the upstream face of the dam.
2. Supply and distribution lines consisting of 44 miles of pipe from 60 in. to 16 in. in diameter.
3. A distribution reservoir located a short distance north of the city and containing approximately 65 million gallons of available water.
4. A chemical adjustment and sterilization plant, at which the pH of the water will be chlorinated and automatically adjusted for corrosion supression.
5. The laterals from the distribution mains to the property lines of consumers.

This paper, however, will deal principally with the design and construction features of the supply and distribution mains, leaving other features for a subsequent paper to appear in this magazine. In a previous paper (WATER WORKS AND SEWERAGE, November 1936) this project was described in general and financing methods were set forth. It is being constructed jointly with WPA and PWA funds, final approval of the project having been granted January 12, 1936.

In order to put a large number of men to work at the earliest possible date, surveys, plans and specifications were prepared for the WPA part of the line first. Contracts for the purchase of pipe were let as follows:

February 20, 1936, approximately 25,000 ft. of 24 in. and 16 in. Cast Iron Pipe and Specials—$108,505.00.

April 30, 1936, 58,460 ft. 60 in. Steel Pipe 3/8 in. thick; 6,000 ft. 54 in. Steel Pipe 11/32 in. thick; 35.500 ft. 48 in. Steel Pipe 5/16 in. thick; 21,900 ft. 42 in. Steel Pipe 9/32 in. thick; at a total cost of $1,121,629.50.

The contract for pipe for the PWA portion of the job, providing for 86,600 ft. of 60 in. steel pipe and specials, was awarded July 11, 1936, at a total cost of $983,840.00.

The cast iron pipe was furnished by the U. S. Pipe & Foundry Company. Both contracts for steel pipe were awarded to the Chicago Bridge & Iron Company and Ingalls Iron Works Company, both of Birmingham, on joint bids. The first, being for the WPA, was purchased through the Procurement Division of the U. S. Treasury Department. In order to give the earliest possible deliveries and to complete deliveries as promptly as

The Barrel of an Enamel Lined 48-ft. Length of Pipe

*This is the second of a series of articles descriptive of the unique and important industrial water supply project of Birmingham. The first appeared in WATER WORKS AND SEWERAGE for November, 1936, and others are to follow.—Ed.

**Member, Engineering Commission, Birmingham Industrial Water Supply.

Tangent of 60-Inch Line Along L. & N. Ry. Right of Way

possible the successful bidders arranged for the pipe to be fabricated in five different fabricating shops, 1,000 tons each by Taylor Forge Company of Chicago and Alco Products Company of Dunkirk, New York, with the balance of more than 10,000 tons being fabricated in the Birmingham shops of the successful bidders, and the Nashville Bridge Company of Bessemer (Birmingham District). When this contract was placed the field surveys had not yet been completed and the exact number and location of specials was unknown. This was also true of the lateral connections. The order therefore contained a provision for numbers of specials of each type, being designated as "not to exceed" certain numbers. It was necessary for all air, vacuum and drain valves and lateral connections to be welded in the field.

The second contract, namely, for the PWA portion of the pipe line was awarded by the city of Birmingham, and this contract was executed in the three local fabricating shops. The field surveys had been completed before plans and specifications were submitted to bidders and the pipe furnished under this contract had all connections put on in the shop except certain minor manually operated air valves which were placed at points where minor breaks in grade occurred due to certain field changes. These were generally less than one foot but were usually on humps where the air bubble would be one-hundred or more feet in length. It is not anticipated that these manual air valves will be used after the line is once filled with water, except in case of the line being completely drained sometime in the future.

The contract for erection of the PWA portion of the pipe line was awarded to Christie Hutchinson & Burton Company of Birmingham, August 10, 1936, at $269,508.00.

Construction Features

Manholes were fabricated in the shop and were spaced approximately 1,000 ft. apart, being usually located in low places in order that the line might be pumped dry after being drained as much as possible through the blow-offs. The manhole covers are provided with two inch cocks through which the line may be pumped down in case of necessity. All manholes are twenty inches diameter, inside, and covers are held down with nuts of bronze to eliminate nut freezing.

Fabrication and Testing

All pipe was fabricated from steel plates made by the Open Hearth Process in accordance with the A. S. T. M. specifications, Serial designation A-10-34, except that the Silicon content did not exceed .05 per cent. The pipe was welded by the electric shielded arc method, the type of welding rod and procedure followed being decided by the fabricator. Short sections of pipe or curved sections were used for all horizontal and vertical curves. Deflections up to two degrees were permitted in a coupling—Dresser type being employed. The straight pipe was fabricated by the various shops as follows:

Alco Products Company, 2 40 ft. plates edgewise, 2 long'td'l. seams.

Taylor Forge Company, 4 20 ft. plates edgewise, 2 long'td'l. seams, 1 Girth seam.

Nashville Bridge Company, 4 22 ft. plates edgewise, 2 long'td'l. seams, 1 Girth seam.

Chicago Bridge & Iron Company, 6 8ft. plates, l'gthwise, 1 long'td'l. seam, 5 Girth seams.

Ingalls Iron Works Company, 6 8 ft. plates, l'gthwise, 1 long'td'l. seam, 5 Girth seams.

Ingalls Iron Works Company, 4 24 ft. plates, edgewise, 2 long'td'l. seams, 1 Girth seam.

The joints used on this job are probably the longest lengths of pipe (48 ft.) ever used on a major job to the extent employed.

It is desirable in making pipe with girth seams that the edges of the plate for the girth seams be planed in order to insure sraight pipe and also the ends should be planed for couplings. The welds were chipped or ground smooth for a distance of 10 inches from the ends to permit the proper placing of the friction type couplings. Each completed section of welded steel pipe and specials, before coating, were subjected in the shop

to a hydrostatic pressure such as to give 18,000 pounds unit stress. While under pressure each was given a thorough hammer test which consisted of striking the pipe with a hammer using sharp ringing blows at 6 in. intervals on both sides and for the full length of all welded joints. One section of 60 in. pipe was tested to failure at the plant of the Chicago Bridge and Iron Company. It failed at 715 pounds, or more than three times the required test pressure of 225 pounds.

Cleaning, Lining, Coating

After testing, all pipe was cleaned inside and outside with a mechanically operated wire brush. Shot blasting or sand blasting was optional under the specifications. After the pipe was cleaned it was primed with a bituminous primer. A lining of bituminous enamel 3/32 inch thick, with a 1/32 inch plus or minus tolerance, was applied centrifugally while the pipe was rotating at a high rate of speed. A coating having an average thickness of 1/16 inch, with plus or minus tolerance of a 1/32 inch, was applied with a spreader while the pipe was revolved slowly. The coatings and linings used on this pipe were Bitumastic Enamel, furnished by Wailes Dove-Hermiston Corporation. Immediately after the application of the lining and coating of all of the interior and exterior surfaces they were tested for pin holes and thin places by an electric device carrying 15,000 volts; and any thin places, or "Holidays" indicated by the current arcing through the lining or coatings, were repaired to the satisfaction of the engineer. Immediately after the "Holiday test" all pipe was whitewashed to reduce heat pick-up while pipe was laying along the trench side.

Initial shipments of pipe had wooden cross braces erected in the ends but, on account of lining being marred and the pipe getting out of round because braces became loose, practically all the pipe was shipped with the stiffening follower rings of the Dresser couplings having been slipped over the ends of the pipe at the point of fabrication.

All pipe fabrication was inspected by a commercial testing firm. Certified mill reports were accepted for the steel. The fabrication inspection consisted of visual inspection of all steel before fabrication, tensile and bend tests of welds; full time inspection of all welding and witnessing of hydrostatic tests; the inspection of lining and coating material and analyses of heats (batches) at point of manufacture; full time inspection of the application of lining and coating; and witnessing of all "Holiday" detector tests. Also checks were made of the ends of the pipe for roundness and for length of pipe; and all couplings were rigidly inspected upon arrival. In addition to inspection by the commercial laboratory, the city had full time inspectors at the fabricating plants to inspect all fabricating and lining operations, and to accept the pipe.

Most of the 60 inch pipe which was laid parallel to the Louisville & Nashville Railroad was shipped in trainload lots at weekly intervals. The contractor leased a work train every Sunday for unloading along side of the trench. Smaller sizes, which were in city streets, were shipped by truck. All pipe was purchased for delivery at the trench site. The pipe shipped by rail was loaded on cars, three or four sections to each car, on concave blocks which were well padded with heavy paper or other material to prevent injury to the bituminous coating. Similar protection was provided between adjacent pipe and layers of pipe on the cars. Pipe was unloaded with drag lines using a single sling with 12 inch webbing belt. A similar method was used in placing pipe in the trenches. When pipe was unloaded it was placed on blocks so that it was not in contact with the ground.

The original design contemplated a minimum of 2 foot cover over all pipe. Increasing construction costs after funds had been allotted, plus a substantial in-

Determining Soil Resistivity Along the Trench Wall with Shepard Earth Resistivity Meter

Some Tough Going on 60-Inch Line. (Rock at Surface and None Too Much Room between Railroad and Highway)

crease in the amount of rock encountered over that indicated by the preliminary surveys, caused plans to be changed over a considerable portion of the line and the 60 inch pipe was in general laid in trenches 4 feet to 5 feet in depth. The distribution lines followed the original plans and were laid with 2 to 4 foot cover. Trench widths were 18 inches greater than the inside diameter of the pipe, except at the couplings where the width was 4 feet greater than the pipe. Rock was excavated 6 inches below grade and backfilled with clean earth.

Electrolysis Surveys

Electrical resistivity of soil is an important index of its corrosiveness to pipe lines. It has been demonstrated that if local corrosive areas along proposed pipe lines can be determined, and proper protection methods used, great economies and prolonged life of the pipe is possible.

The Shepard Earth Resistivity Meter (Shepard Rod) is a simple piece of apparatus, which was used in the soil resistivity tests on this project. This instrument was developed by the U. S. Bureau of Standards in connection with its soil corrosion work for the measurement of the resistivity of earth in place, without the necessity of taking samples to the laboratory. This instrument is now in general use by a number of oil and gas pipe-line companies.

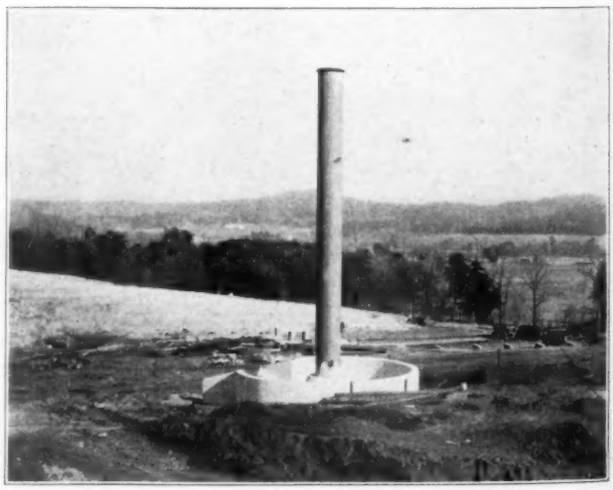
When the actual excavation of the trench for the pipe line began, soil resistivity readings were taken with the Shepard Rod, as the trench was opened ahead of the pipe laying. All readings were made immediately after the trenches were opened in order that normal soil conditions would be recorded. The readings were taken at one foot intervals, beginning at the bottom of the trench. The Shepard Rods were punched into the side of the trench wall and the observed soil resistivity was recorded. At a later time these readings were plotted on a cartogram sheet as a part of the permanent record of the soil resistivity of the pipe line. In areas where the resistivity of the soil was uniformly high (10,000 ohms per cubic centimeter or higher) readings were taken at two hundred foot intervals. In areas where the soil resistivity was varying, or where a more accurate check was desired, readings were taken every one hundred feet. In the low resistivity areas, where special protection of clay or sand blankets was put around the pipe, a great number of readings were taken in order to determine just where the low resistivity sections began and ended. The clay blankets were so put around the pipe that they extended about twenty-five feet beyond the points of low soil resistivity. In view of the fact that all the steel pipe on this system is coated, a minimum resistivity of 1,350 ohms per cubic centimeter was taken as the index of areas through which clay blankets should be wrapped around the pipe.

Test Risers Installed

After the laying of the pipe was completed, test risers were bolted to the bottom of the manhole flanges so as to give a good electrical connection to the pipe. The free ends of the test wires were brought to a point about eight inches below the surface of the ground, so that it will be an easy matter to uncover these risers and make later tests to determine the pipe line polarity with respect to the surrounding soil. By so using these test risers it will not be necessary to open the trench or in any way mar the pipe coating when making such tests. These wires will also be used to study the potential gradient measurements along those sections of the line where street railway rails parallel the pipe line. In sections where the pipe is negative no trouble from corrosion due to stray currents is anticipated. In sections where the line is positive, careful study will be made in order that the proper protection methods can be applied before the pipe becomes damaged from corrosion.

At each point where test risers were installed, a lead wire was brought from the same pipe flange and tied to 3 by 6 inch pipe "coupon", made of the same material and of the same thickness as the pipe. All coupons were carefully weighed before being installed on the pipe line. When these coupons are inspected, should signs of corrosion be noted, they will be taken up and reweighed to determine the corrosion loss. By this method the rate of corrosion loss of the pipe, if any, can be determined. These test risers and pipe coupons are spaced at intervals varying from 600 to 1,500 feet. Every fifth coupon is coated with the same bituminous material which was used in coating the pipe. This was done so that a study could be made on the life of the pipe coating also. Periodic re-weighing of the coupons and constant study of the pipe potential will permit a careful watch on possible pipe line deterioration. Such a program properly carried out should prolong the life of the pipe indefinitely.

A number of nipple and can tests have been made to determine the corrosivity of the various soils through which the pipe line is laid. When a known index can be established for the nipple and can tests it will be possible to tie these tests in with the resistivity tests, and



42-Inch Surge Riser on Line from Supply Main to Distribution Reservoir

Installing Cross on 24-Inch C. I. Distribution Main—This Being on the WPA End of the Project

thus the two methods of testing can be made to check against each other.

Pipe Laying

After the trench had been prepared rubber joint gaskets were slipped on the lengths of pipe to be joined and the middle rings was slipped on the end of the pipe in the trench. The length of pipe next to be laid was then lowered into the trench as described above and laid like bell and spigot pipe. The middle ring of Dresser couplings, being flared at each end, guides the pipe into proper position. Most of the pipe used was fabricated in sections 48 feet long. It was therefore necessary to use extreme care to get uniform bearing throughout the entire length of these extremely long sections. The jointing crew consisted of four men. This crew worked so that one man tightened the bolts on each quadrant with ratchet wrenches (with gauges) until they had become experienced in noting the tension on the wrenches. The gauges were then used only for occasional checking. There were 34 bolts on each 60 inch coupling. The couplings had a coat of primer applied before placing in the trench in order that there might be no delay in backfilling the bell holes due to waiting for the primer to dry for a period of 24 hours before applying the bituminous coating to the joints. The method of applying this coating was by suspending a pan of proper width and made to fit around the lower half of the pipe, and by pouring hot bituminous jointing material over the coupling to completely cover the middle ring, follower rings, bolts, and the uncoated portion of the pipe. The excess compound was then drawn off through a valve in the bottom of the pan and the pan removed. We found that it is essential that the bell holes be deep enough to properly receive the bucket in which the excess bituminous material is to be recovered. And, likewise, that it is important that the coupling compound be heated to the proper temperature in order to secure satisfactory results. It is also mandatory, in hot weather, to whitewash the top half of the couplings in order to prevent softening of the bituminous material. It may be noted here that some cities require complete whitewashing of the couplings in order to relieve soil adhesions and possible damage to the coating.

The trench was backfilled by placing clean material in 6 inch layers and tamping thoroughly up to the springing lines in shallow cuts and to the top of the pipe in deep cuts and in city streets. The contractor on the PWA part of the work used air tamping while the WPA used hand tamping. Because of the light weight of the pipe it was necessary in tamping to use care to avoid lifting the pipe above the original grade. Also it should be noted that water tamping cannot be used. All backfill, above that which was tamped, was placed by a drag line, care being taken not to drop heavy materials or masses directly on the pipe. It is essential to keep backfilling well up with the pipe laying at all times in order to prevent the pipe from floating after a rain, and to protect the pipe from the heat of the sun, and from mechanical injuries. When the trench was in rock, clay was hauled in to backfill around the pipe. When the pipe line was under a railroad the pipe was laid in the clear, through reinforced concrete culverts.

Laying Speed

The contractor on the 60 inch line was able to lay more than 3,000 feet on each of several eight hour shifts. He used a 1¾ yard trench hoe for excavating the trench, a 1½ yard drag line for laying pipe and a 1½ yard drag line for backfill. Fine grading and bell-hole work were done by hand. Due to the quantity of rock encountered the average speed of laying was only a small fraction of the above. An inspector was on the job at all times to inspect the fine grading, the laying of the pipe, the making and coating of the joints and the backfill of the entire line.

Field Cutting and Welding

It was sometimes necessary to cut original lengths of pipe, due to unforeseen obstructions and other difficulties. This was easily done in the field but in so doing it necessitated the use of an extra coupling. It is therefore an excellent precautionary measure to provide a few extra couplings for unforeseen use. It has also proved desirable to provide at least a two per cent greater number of bolts than is actually necessary for use in the couplings. A feature of steel pipe proved to be—that, if unforeseen changes in line or grade necessitates, a slight bend can easily be made in the field by merely cutting a straight length pipe on the desired angle, rotating one end and rewelding.

All pipe was inspected immediately before laying and any abrasions in the lining or coating were repaired. After the pipe laying was completed and the inside of the pipe thoroughly cleaned, a further inspection of the lining was made and any touch up work found necessary was done as the inspection progressed. Also, at this time, all joints were coated on the inside with bituminous enamel, thus giving further protection to the inside surfaces of the Dresser couplings and the very ends of the pipes, where possible chipping of lining may have taken place during handling and laying.

A 42-Inch Sectionalizing Valve on 60-Inch Line. (Note Venturi Type Reducing Section to Minimize Head Loss)

Floated Pipe

There were many cases where pipe had not been backfilled before heavy rains occurred. In several instances the pipe floated in the trench and at twelve locations, involving a total of approximately 4,000 feet, the pipe floated even after backfilling, indicating limits to shallowness of back-fill. It is desirable, therefore that a substantial backfill section be maintained. It seems absolutely essential, also, that drainage be watched very closely.

Valving

The entire pipe line system is sectionalized by means of gate valves. The distance between valves varies from 7,000 feet in the city to 44,000 feet on the 60 inch line in the open country. On the large lines valves smaller than the pipe were used. The valve sizes adopted were as follows: 30 inch on 42 inch lines; 36 inch on 48 inch lines; 42 inch on 54 and 60 inch lines. All these valves were flanged and the reducers were proportioned as venturi tubes in order that the head losses might be reduced to a minimum. On the 24 and 16 inch cast-iron lines hub-end gate valves of the diameter of the pipe were used. The larger valves are placed with stems horizontal and are equipped with beveled gears operated by a hand wheel. All operating valve mechanisms were installed in a reinforced concrete valve box or vault. All of the large valves were furnished by the Ludlow Valve Manufacturing Co.; and the valves 24 inches and under by M. & H. Valve & Fittings Co. Immediately below the dam one check valve was installed. This is a Ludlow 42 inch multiple port check-valve, installed between the suction and the discharge tees placed in the line for the future pumping station. Its purpose is to prevent the booster pumps from discharging into their suction.

Blow-off valves were placed in all major sags. Blow-off valves vary from 4 to 16 inches, depending upon the length and diameter of line to be drained. A standard blow-off consists of a built up flanged saddle nozzle welded to the pipe, a flange and spigot short length, a hub-end gate valve and bell and spigot pipe to the outlet. Valves are fitted with 2 inch square operating nuts and have standard extension valve boxes placed over them. All of these valves were furnished by the M. & H. Valve & Fitting Co.

Air Valves

Automatic air release valves serve to allow air to escape while filling the line, to allow air to enter when the line is drained for any cause, and, to release air which will accumulate under pressure at high points on the line during the normal operation of the pipe line. Crispin air-valves were used throughout the system. Such valves are installed both singly and in clusters. Flanged saddle nozzles two inches, four inches, six inches and eight inches in diameter are welded to the pipe. Each of the two inch and four inch nozzles have one 2 inch and 4 inch air valve respectively. The six inch nozzles have two 4 inch air valves and the eight inch nozzles have four 4 inch air valves bolted on a 6 x 4 x 4 and an 8 x 4 x 4 x 4 x 4 C. I. assembly casting, respectively. These clusters were used to eliminate the necessity of large single valves which might stick and destroy the usefulness of the valve. Gate valves are installed in the risers to all air valves. In the open country air valves are protected by a 42 inch round housing made of ¼ inch plate, with a hinged cover. In all places where traffic conditions require the housings are made of brick with a reinforced concrete top in which was placed a 20 inch cast-iron manhole frame and cover. Manual release air valves were also installed at selected points, as previously described.

Anchoring

Concrete anchors were provided at all horizontal bends in the line, having an angle of 15 degrees or more. The anchors were poured completely around the pipe and to the edge of the trench, preventing any reaction on back-filled earth. These anchors were so proportioned as to be safe against sliding and overturning; assuming 50 per cent as the coefficient of friction for sliding for earth bearing, and 100 per cent for rock bearing. No allowance was made for tensile or shearing strengths in the pipe joints. Anchors were also provided at all vertical bends having an angle of more than 4 degrees, unless extra heavy backfill and other special conditions made them unnecessary. In the design of these anchors for vertical bends advantage was taken of the weight of the lengths of pipe adjacent to the anchors, including the water contained therein. As in the case of the horizontal anchors, no allowance was made for tensile or shearing strengths in the joints.

Water Hammer Precautions

A surge tank is placed in the 60 inch line about 21 miles from the impounding dam and 6 miles from the point where the line branches into one 54 inch and one 24 inch line. This tank consists of a 42 inch diameter riser, the top of which is one foot above the high water level at the dam. Any surge overflow is caught in the concrete basin at the foundation and returned to the distribution reservoir.

Water hammer was computed, based on the theory of L. Allievi published in his "General Theory of Variable Motion of Water in Pressure Tubes." Using Allievi formulas, it was found that all steel pipe was amply safe from water hammer. But, under a combination of adverse circumstances the cast iron pipe at the lower end of the line might be subjected to pressures above the working pressures of the pipe. For this reason a relief valve assembly consisting of two 4 inch automatic cushioned diaphragm-operated valves, mounted on a 6 x 4 x 4 wye casting, was installed in this line. This relief valve discharges into a creek through about 30 feet of 6 inch pipe.

Personnel

This project was designed and constructed under the direction of the Engineering Commission for the Industrial Water Supply, composed of J. D. Webb, Chairman, O. G. Thurlow and the writer. The Executive Engineer who is in direct charge of all design and construction is A. C. Polk. The Designing Engineer was H. J. Peterson. The distribution system, including all steel and cast iron mains and all laterals to consumers and the distribution reservoir, was under the direct supervision of Harry H. Hendon as Resident Engineer on Distribution System. The electrolysis survey was in charge of W. W. Garrett, Electrolysis Engineer.

As noted previously, this project was financed jointly by the PWA and the WPA. The State PWA Administrator was H. S. Geismer, the Project Engineer was Wendall S. Merick and the Engineer Inspector was W. G. McConnel. The WPA portion of the work was under the direct supervision of W. D. Twing, District Director, and Walter Schoel, Area Engineer.

The author wishes to acknowledge the valuable assistance of Mr. Peterson, Mr. Garrett and Mr. Hendon in furnishing the data used in this paper.

THE MUNICIPALITY AND ITS WATER SUPPLY*

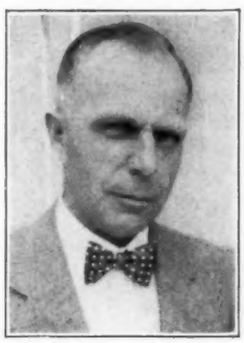
By WILLIAM C. EMIGH
City Engr. and Supt. of Water & Sewage, Coatesville, Pa.

In the opening paragraph of this paper the author shoots straight—hits the bull's-eye squarely.

This article by Mr. Emigh will give many a reader the inspiration lacking in the matter of talking "shop" with the public.

Here is a paper which will serve as a "tailor-made" speech for the water works manager, superintendent or chemist, who has the opportunity of addressing the public, the Rotary Club, or the like, on "Water Supply and Its Relation to the Municipality."

Mr. Emigh's paper can be used to excellent advantage as the basis of a printed booklet for distribution. Also, as "copy" for the Editor of the local newspaper for a series of articles.—Ed.



The Author

IT can hardly be denied that the weakness of engineers and technical men, as a group, has more often been manifest in their failure to place engineering principles and practice before the public in understandable and convincing manner than in a lack of technical knowledge. Most engineers who have occasion to speak to groups of laymen on technical subjects have at some time been somewhat chagrined to realize that their audiences have been bored by their use of scientific terms, or too much detail of a technical nature. Nevertheless, until technical men "sell" themselves and their professions to the public they will not receive the recognition they deserve, and should seek. Also, it often happens that the very proximity of a man to his work makes it difficult for him to maintain a correct perspective, one which he can effectively translate and present to an ordinary business man. It is so easy to assume that the listener or reader has a rudimentary knowledge of the subject that the technical man must always recall that such is not the fact.

The following remarks are offered, not with the thought of adding to the knowledge of water works men, but in the hope of suggesting an approach in presenting a comprehensive view of the facts behind the water works utility so simple that non-technical men, municipal officials or citizenry, will readily understand its fundamental principles and objectives.*

Some Water Works History

To those interested in public water supplies some of the most interesting pages of ancient history are those pertaining to the construction of public works designed to provide water supply for cities or other centers of population. We find among some of the most ancient ruins structures which once formed parts of water supplies used for domestic or irrigation purposes. Some 4,000 years ago immense water works had been constructed in the, then, densely populated valleys of the Euphrates and Tigris Rivers. Lake Moeris, in Egypt, constructed about 2000 B. C., was the largest of the reservoirs of the Nile Valley which, at that time, supported some twenty million people, four times the present day population. In China, wells were dug to depths of 1,500 feet. Ancient Greece, India and Persia had their water works structures and there is evidence that in prehistoric times a race, now extinct, had constructed extensive irrigation works in Arizona, New Mexico and Central America. There are several biblical references to the construction of water works.

Probably the most remarkable water works of ancient times were constructed by the Romans who, when the water of the Tiber became too badly polluted to provide a satisfactory source of water supply, constructed the far-famed Roman aqueducts to bring water from the surrounding hills. The first aqueduct was placed in service in 312 B. C. and by 305 A. D. (617 years later) there were nineteen aqueducts supplying the city, having an aggregate length of 381 miles. During the Middle Ages there was little public construction carried on; in fact, the destruction of wars probably exceeded the construction. Doubtless the use of grossly polluted water was in a large degree responsible for the pestilences which ravaged much of Europe during that period.

An Early Water Company

In 1619 a company was incorporated in London to supply water from New River through pipes to individual houses thus indicating the first adoption of the prinples of separate house services. Early water pipes were largely of wood, as cast-iron did not come into general use until about 1800. It is interesting to note that, when water was first supplied to each house, it was thought quite impracticable to furnish a continuous supply, the water being turned on for only a few hours each day, and, as late as 1891, thirty-five per cent of the total supply of London was still furnished on the intermittent system. Public water supplies in the United States date from 1652 at Boston; about 1732 at Schaefferstown, Pa.; and 1754 at Bethlehem, Pa. The first instance where a pumping machine was used was at Bethlehem. Philadelphia, in 1800, was the first to use a steam engine for pumping.

From the foregoing it is obvious that the acknowledgment by government of its responsibility for the procuring of a proper water supply for its people bears the authority derived from a principle, the acceptance of which extends back into dim antiquity. Whether the community water works be municipally or privately owned it must be readily conceded that, owing to the intimate relation of the supply to the health and well-being of the citizens, those intrusted with the affairs of city government owe it to their fellow-citizens, as one of their fundamental responsibilities, to assure them a water supply adequate in quantity and both safe and agreeably palatable in quality. This service may properly be delegated to a company or corporation, if the best interests of the city are served thereby, but there still remains the moral obligation of government to see that safe water and satisfactory service are provided.

*The context of this paper is based upon a highly commended address delivered by the author before an association of administrative city officials.—EDITOR.

Demand and Supply

It is a well recognized fact that the American people, in comparison with European nations, are wasteful. This characteristic, doubtless due in part to our superabundance of natural resources, is reflected in our use of water. We insist that no water supply is adequate unless it not only supplies all our needs but furnishes us, in addition, with a large quantity to waste. There appears to exist in the human mind a belief that water like air, both being "God's gift to men," should be readily available in almost unlimited quantities. This results in so-called consumption (much being wastage) in the larger cities ranging up to 275 gallons per day for each resident, with an average around 150 gallons and minimum of 60 gallons.

Some cities are so situated that they can draw their water supplies directly from a stream which, at all times, provides a flow sufficient for the needs of the community whereas others find it necessary to draw from a stream which so diminishes during dry periods that it becomes necessary to store water in impounding reservoirs during periods of excess flow to be used in periods of inadequate flow. Like the proverbial chain which is no stronger than its weakest link, the adequacy of the available water cannot be gaged by the usual season, or even by an unusually dry season; but, by the *extremely* dry season, which may occur only once in a generation or longer. A supply derived from wells possesses the advantage of more constant flow, but still has its variations which cannot be equalized to any extent by storage; nor, can ground water flows be predicted with the degree of accuracy obtainable in the usual case of surface water.

In addition to the seasonal variations in quantity of water available there are both daily and hourly rate variations in the water consumption. To make water available for the peak demand hours without drawing too heavily upon the source or over-taxing filters or the trunk mains from the source of supply, distributing reservoirs within or close to the city are usually employed. In some cases, however, the inadequacy of mains due to false economy or lack of vision with respect to future growth at the time of installations, or perhaps, due to subsequent tuberculation of the mains, produces excessive hydraulic head losses at hours of heavy draft with resultant unsatisfactorily low service pressures. Having come to expect a rush of water when a faucet is opened the consumer who finds only a sluggish flow or a trickle does not consider his service satisfactory.

What Fire Protection Demands

In the requirements of fire protection there may be a greater demand upon any given part of a system, or even upon the system as a whole, than that which is occasioned by normal use. In the design of any water supply system, and to some extent in operation, the requirements of fire protection are of great importance. With the compacting of buildings in the city, as compared to the isolated structures of the rural sections or villages, comes the added danger of extensive conflagration. A main entirely adequate for domestic, commercial or even industrial service in a given section, may be quite inadequate for proper fire protection. Since dual systems for city use, one supplying safe and the other unsafe water, are hazardous from a public health standpoint, it results that there must be at all times a sufficient reserve of potable water, or reserve filter and pump capacity, to supply water for an unusual fire.

The rapidity with which the frictional losses in the mains increase with reduction in diameters is interesting and, at first glance, perhaps surprising. In addition to the size of the pipe in any street, and its interior condition, there are other factors such as the number and size of feeding mains and the spacing and location of hydrants which are of importance. If the distribution system is adequate for proper fire protection, it will generally be true that the frictional losses in the pipes during periods of normal consumption are not excessive, and that unsatisfactory pressures can only be corrected by providing additional head. The citizen and tax payer expects, and rightly so, that, in case his house or other building is burning, that the fire department will have ample water, under adequate pressure, at its command to extinguish the blaze. Unfortunately the discovery of inadequate water supply for fire fighting purposes sometimes awaits a disastrous conflagration. On the other hand the National Board of Fire Underwriters is keenly alive to the interests of the community in this respect as well as its own interests and is always ready to cooperate in determining conditions which produce fire hazards. Sometimes a reduction in insurance rates, which, in the aggregate, represents a very considerable sum, may be obtained for a community by not overly expensive additions or corrections to the water works system in its relation to fire protection. Surely the reduction of fire hazards and of local insurance rates is a matter which should keenly interest any group of business men, property owners or city officials. The subject should be taken before these groups for clean cut presentation and open discussion. The confidence will be appreciated.

The Community Health

Today, as never before, it is well recognized that the securing of an abundance of water is but the first step toward a satisfactory water service. Although there is a fairly general appreciation at present of the dangers to health which may lurk in drinking water, our understanding of the nature of these dangers is of comparatively recent origin. It is now hardly more than forty years since the death of the illustrious Louis Pasteur, to whom we are indebted for the fundamentals of the science of bacteriology in its relation to disease. Building upon the discoveries and work of Pasteur the development of the science of bacteriology with especial reference to the pathogenic germs of water borne diseases has been rapid. We now know that any water which has been subject to human pollution constitutes a dangerous water unless properly treated.

Because the most dangerous pollution is of human origin it follows that, with increasing concentration of population in cities and villages the problem of securing a safe potable water supply has become proportionately difficult. With the increase of population on a watershed tributary to a given stream there frequently arises a conflict of interest between centers of population which are taking water from the stream for domestic use and discharging sewage and manufacturing wastes into the stream, correctly termed "the spent water supply of a community." The arguments advanced by these municipalities may range all the way between two extremes: the one that no municipality, industry or individual located at a higher point on a stream has a right to pollute the water of the stream or in any way detract from its pristine purity; the other, that the water courses form natural drainage channels and, as such, may properly be expected to carry off the polluted waters of the community.

It is generally considered that the fair and reasonable position lies in the middle ground, wherein the upper

municipality is asked to treat its sewage to an extent sufficient to relieve the water purification works of the lower municipality from dangerously heavy loading. It follows that any municipality which is taking its water supply from a stream polluted by sewage at some higher point is vitally interested in seeing that its neighbor's sewage is treated to a sufficient degree to keep the load on its water filters within the range of safe operation. This is a matter which can be taken to the public as well as the state authorities.

Although there are several diseases which are recognized as of water borne origin, typhoid fever and dysentery have been generally considered to be the outstanding water-borne diseases and their prevalence or rarity has been taken as the criterion of the purity of the water supply. It is true that typhoid can be contracted through milk, oysters and human carriers, yet the most usual source of infection, especially in cases of epidemics, has been polluted water supplies. It is of interest to note that, in the bacteriological examination of water, no attempt is ordinarily made to determine the presence or absence of typhoid bacilli. Instead the usual test is for B. Coli, a normal inhabitant of the human intestine. Should the water works man wait until typhoid germs were identified in the water, before heeding the danger signal, he would probably find himself with an epidemic of high mortality already on his hands.

Industrial Pollution

In addition to pollution of human origin many communities are virtually under the necessity of using water polluted by industrial wastes. The characters of these wastes vary greatly and each type of waste presents its particular problem in the operation of filtration plants. Some industrial wastes produce taste or odor in almost unbelievably enormous dilutions whereas others so alter the chemical characteristics of the water as to necessitate a type of treatment especially designed to correct the effect of the pollution. Development of recent years looking toward the reduction of the deleterious effects of industrial wastes in water supplies have to a considerable extent been along the line of reclamation of these wastes at the source, in some cases making it financially profitable for the industrial establishment to cooperate with the municipality in the matter of reduction of the pollution.

Water Treatment a Chemical Engineering Problem

It is not proposed at this time to go into any description of the several units of a water filtration plant or of the varied processes involved in treatment of the many types of water. It may well be noted, however, that a good grade of potable water produced at a modern filtration plant is as much a manufactured product as is the steel coming from our mills. No two waters are exactly alike and in many cases the character of a raw water from a given source changes not only with the seasons but from day to day. If a good quality of water is to be produced at all times it will be necessary that these variations in the raw water be met by corresponding changes in the treatment at the filter plant. Much of the efficiency of the treatment and purification process depends upon experienced supervision and intelligent operation. In view of the vital importance of having, at all times, an absolutely safe water, too much stress cannot be laid upon a properly trained personnel for the operation of the purification plant nor can it be other than ill-advised economy that will reduce the remuneration of those charged with the operation, until the work no longer attracts a competent type of man in whom lies the responsibility of insuring a safe and potable water in ample quantity to meet demands—emergency and otherwise.

Water which has passed through properly operated modern filters may be considered safe for all domestic purposes. Bacteria will have been largely removed and B. Coli will seldom, if ever, appear in the filtered water. It is considered good practice, however, to add another safeguard, a germicide. Although there are a number of germicides and germicidal processes which have been, and can be, used, the field of disinfection of public water supplies has, at the present time, narrowed down to the almost exclusive use of chlorine gas. Although some water consumers profess to believe that their water is merely a dilute solution of chlorine, the actual quantity of gas required for effective germicidal action is extremely minute. It may be possible to gain some conception of the relative proportions of water and chlorine by considering that an average rate of application of chlorine bears about the relation to the water treated that one-eighth of an inch does to five miles. And it must be recalled too, that one-half of the table salt that we use is chlorine. From table salt the sterilizing chlorine is produced.

The Hazard of Cross-Connections

At this point it may be well to call attention to the very real danger which exists where there is a cross-connection between a potable water supply and a privately owned supply—frequently of polluted water. The temptation is often great to make these connections, especially in industrial plants, in order to provide additional fire protection or for other reasons. There is always a valve, generally a check valve, and often double check valves, so that, apparently the polluted water cannot possibly reach the mains of the potable supply; yet a study of the causes of typhoid epidemics indicates that in a surprising number of cases it has been the "impossible" combination of conditions, failures, or circumstances which did occur and which permitted the polluted water to reach the public water supply. It is because of this array of historical facts that every state health department wages war on cross-connections and, in the interest of the health and life of the people of the community, should have the whole hearted support of every right thinking citizen as well as conscientious municipal officials. The water works manager must continually be on guard against such hazards to the public health.

A Pleasing Water Demanded

We have now considered briefly the sufficiency of quantity and the safeness of our water supplies for human consumption. But a water may be available at all times in abundant quantity and be absolutely safe to drink, yet be almost impossible as a potable water owing to tastes, odors, or both, resulting from the presence or former presence of minute forms of plant life generally known as algae, or industrial wastes, or the products of vegetation decay. In the history of water treatment development there may be noted three more or less definitely marked chronological divisions:—the development of the technic of filtration designed to accomplish the removal of turbidity and bacteria; the development of the germicidal chlorination process as employed today and the apparatus required for it; and, lastly (but not least in importance today), the improvement of the palatability of the water. At the present time more attention is being given to the control of tastes and odors than at any previous period. The problem is attacked at two points:—the source, by killing the growth of algae,

or abatement of industrial pollution, and within the plant by the introduction into the water of materials which have been found to be helpful in destroying or removing tastes and odors from the water. The most prevalent trouble is the growth of algae—not dangerous but very distressing. Unfortunately, the killing of algae in reservoirs does not immediately improve the tastes and odors, in fact, may even aggravate them if the growth gets much headway before treatment is applied. Although the classified types of plant life known as algae number thousands, only a comparatively few types have been reported in water supplies in sufficient quantities to cause serious trouble. Generally the algae can be controlled by proper treatment and operation. Tastes and odors are prevented thereby or greatly reduced, if not entirely eliminated.

Industry and Water Quantity

So far we have discussed principally those qualities of water which bear directly upon the suitability of the water for domestic use and human consumption. Another characteristic of water supply which should, and does, interest almost every community is its mineral and gaseous content. It may fairly be stated that every natural water contains some mineral matter. The kind and amount of mineral salts will largely determine the fitness of the water for industrial use. The most commonly observed effect of mineral salts, one which reaches both the householder and the industrialist, is hardness. Investigators have endeavored to estimate the cost to a community of hard water as compared to a naturally soft or artificially softened water, and have found it running into surprisingly large figures. Several processes for the more or less complete removal of hardness are available and are now coming into quite extensive use.

It is quite possible that, in the efforts of communities to attract and secure industries, the chemical character of the water available, in its relation to the requirements of a particular type of industry, has not received that attention and study that its importance warrants. It is entirely feasible to remove by treatment, especially designed for a given water, many of the substances which may, if present, render the water unfit for some industrial use. At the present time water works men are giving considerable attention to methods of rendering water less corrosive which, when accomplished, may effect large savings to propery owners and industry in the cost of renewal of piping.

The Economics of Pumping Means Much

Many communities are under the necessity of pumping a part or all of their water. Pumping conditions vary so largely (each installation presenting an individual problem) that it is difficult to make general observations concerning them. The hydraulic factors involved in a particular installation often are quite complicated and require careful study, by one thoroughly qualified in that field, in order to obtain the most economical results consistent with satisfactory service. In some cases it may be possible, with electrically driven pumping units, to secure rates for off-peak hours sufficiently attractive to justify a rearrangement of pumping schedules to take advantage of the lower rates. It is important to note that in recent years the improvement in the efficiency of pumping equipment has been so marked that a marked saving may sometimes be effected by the installation of new pumping units even though the old ones appear to be in good condition and operating satisfactorily.

In every public utility business—and the water works of a community whether municipally or privately owned is distinctly a public utility—one of the most important features is the rate structure. Because it appears to involve the least initial expense, and perhaps offers the path of least resistance, many municipally owned plants use a flat rate schedule, often based upon the number and kind of fixtures. The relation between the number of fixtures, or other basis of flat rate charge, and the volume of water drawn, is frequently so remote that it is difficult to justify that method of proportioning water revenues.

The alternative to flat rates is usually meters, with charges based wholly or in part upon the amount of water used. It then becomes necessary to formulate a meter rate schedule and to this schedule careful thought and study should be given. Such a study will indicate that a considerable part of the cost of producing and delivering water, such as debt service on both the producing and distributing plant, would continue independently of a reduction in the quantity of water consumed. Attempts to establish rate schedules, which would give to this factor due weight, have resulted in the use of various expedients. The names of some are more odious to the public than others but whether it be called "minimum charge," "meter charge," "sliding scale," "service or readiness-to-serve charge," or "demand charge," as is the practice of many electric power companies, it must be recognized that the portion of the cost of service, which is independent of the amount of water consumed, must be covered openly or otherwise. Whatever may be one's personal attitude toward these rate systems it is obvious that water can be delivered at a much lower cost per gallon in large quantities, such as required by large industries, than in small quantities such as used by the average householder. It would thus appear that, both from the standpoint of cost to produce and deliver, and from that of offering encouragement to local industries, a much lower per gallon rate for large consumers, whether arrived at by means of a sliding scale, a meter charge with a low gallon rate, or some other method, is justified.

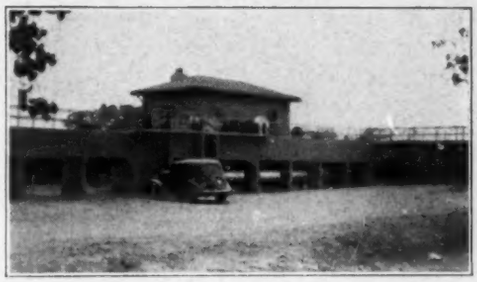
In conclusion, it may be stated that it has not been the intent of this discussion to enter exhaustively into any single phase of water supply. In fact, it has been possible, because of the comprehensiveness of the subject, to do little more than catalogue some of the aspects of public water supply. Those discussed are of vital importance to the community and should, therefore, be of interest to any intelligent and public spirited citizen as well as to every public official.

▼

In New Orleans A.W.W.A. Selects the Roosevelt

American Water Works Association headquarters announces that all requirements of the Convention Hotel Committee and Convention Management Committee having been met by Hotel Roosevelt in New Orleans, that hotel has been selected as the headquarters hotel for the 1938 Convention, April 24-28. A number of single rooms at the minimum rate of $3.50 have been guaranteed the Association for members who make early reservations.

Nearby Hotel Jung was a close contender in its efforts to secure the Convention, lacking only in exhibit facilities. Members failing to find suitable accommodations at the Roosevelt should keep Hotel Jung in mind.



Laboratory and Chlorinator Bldg., El Paso Sewage Treatment Plant

FERRIC CHLORIDE TREATMENT AT EL PASO

By CHARLES D. YAFFE

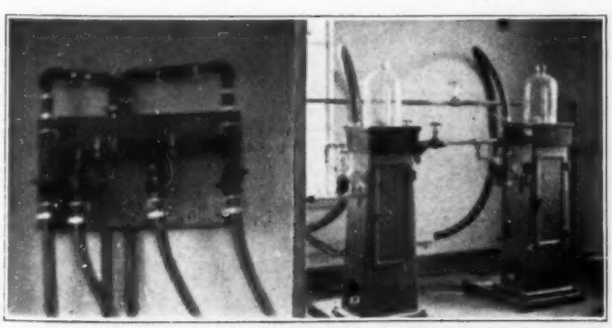
Supt., Sewage Treatment Works, El Paso, Texas

The Author

THE renovated sewage treatment plant at El Paso, Texas, remodeled to employ chemical precipitation, was put into service February 1, 1936. Operating results obtained during the first seventeen months of operation are presented and discussed in this article.

El Paso, a city of 100,000 people, is located in the extreme west corner of the state. The climate is arid, the rainfall averages slightly under ten inches per year. Sewage flow averages six million gallons per day, with a minimum of about 4.5 million and a maximum of about 7.5 million gallons per day, except in the case of a heavy rainfall when the flow may reach nine or ten million gallons. The average daily maximum rate is around nine million gallons.

Sewage reaches the plant through three lines. Approximately 60 per cent of the flow, including the sewage from the business district, is pumped from the main pumping station located half a mile north of the plant. This station has one 2,000 gpm. pump and one 4,000 gpm. pump. These are directly connected to 25 and 50 hp. motors respectively. In addition there is another pump with a capacity of about 7,000 gpm. This unit is belt driven and can be run either by a motor or by a gasoline engine, for use during heavy storm flows or power failure. The gasoline engine has proved a "life-saver" on several occasions when there were interruptions in power service. Bar screens are used at this station.



Chlorine Water Distributing Panel and Chlorinators (See Sketch for Flow Scheme)

About 40 per cent of the flow, largely from residential sections of the city, reaches the plant by gravity through an inverted siphon 7,200 feet long.

The third line to the plant is from the Val Verde pumping station located a quarter of a mile east of the plant. The flow through this line is very light (less then 250,000 gpd.) from a section of the city which does not as yet have many sewer connections. The station has two 300 gpm. pumps which are automatically operated by float controlled switches.

Course Through Plant

The three lines merge at the plant. The sewage runs first through two 25 inch Chicago Comminutors operated in parallel, thence through two grit chambers also arranged in parallel. Grit is removed continuously by Link-Belt drags, thereafter being discharged by dewatering screws into a hopper from which it is removed daily and hauled away. Grit removed averages about a yard per day.

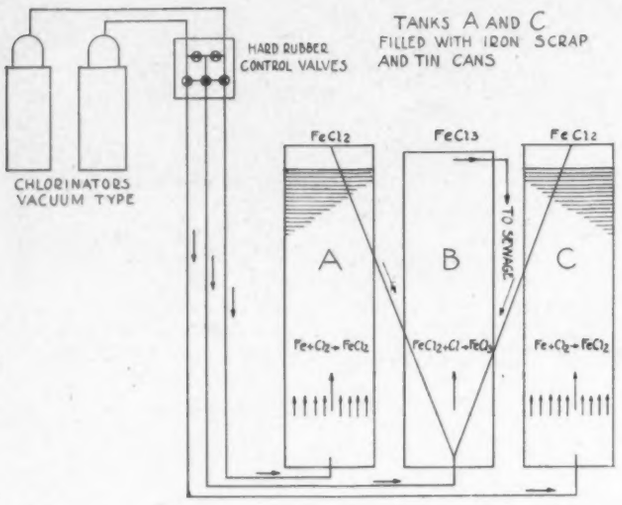
Beyond the grit chambers are the mixing chambers, where the coagulant is added. Mix and flocculation are accomplished by air-blowing through 55 diffuser plates located in the bottom of the tank. Of the ridge and furrow design, the tank is 69 feet wide, 18 feet long, 12 feet deep. Air is supplied by two Root-Connersville blowers of 100 cfm. capacity each.

After the mixing period of 10 to 15 minutes, the sewage passes into a sedimentation tank 126 feet long, 75 feet wide, and 10 feet deep. Sludge, therefrom, is removed continuously by Link-Belt drags which also skim the grease and floatables from the surface into a "trap." A cross-drag brings all of the sludge into the central sump, from which it is pumped to the digestion tanks.

The effluent passes over V-notched weirs on both sides of a trough which thus doubles the weir length. It runs from this trough into a conduit which leads to a Venturi meter at the entrance to the outfall line to the Rio Grande River, one half mile south of the plant.

Old Plant Units More Than Needed With Chemical Precipitation

The old plant, which gave inefficient service before being remodeled, consisted of 15 oblong plain subsidence tanks, arranged in two batteries of six tanks on one side and nine on the other. With the new arrangement, three of these tanks are not required and have been left unchanged. They will only be utilized in emergency



Sketch Showing Arrangement and Flow Scheme from Chlorinators Through Generating Towers, Producing Ferrous and, Then, Ferric Chloride

treatment, and can be made into a mechanically cleaned unit when the necessity for increased plant capacity arises. The other three tanks, of the battery of six, were converted into the mechanically cleaned sedimentation tank.

The nine tanks on the other side were remodeled to serve as sludge digesters, three having been covered and equipped for gas collection. Baffles extend the length of the covered digesters, forcing the sludge to travel the length of each twice. The six open tanks are not baffled but the openings connecting them are located at opposite ends to obtain progressive displacement with digestion progress.

The sludge enters the first tank and passes in series through the nine tanks. The digesters are each 75 feet long, 41 feet wide, and 11 feet deep. The covered digesters have a combined capacity of about one foot per capita, and the open tanks (made useful at little cost to serve principally as sludge storage units) bring this figure up to approximately three feet per capita.

Foaming Troubles

When the plant was first put into operation the digesters were filled with raw sewage, which was gradually displaced as sludge was pumped in. Several weeks after operations began (with appearance of warmer weather) a foaming attack took place. The pH of the sludge dropped to 6.0 and the specific gravity to about 0.6. Foaming sludge, passing into the first open tank, naturally rose to a higher level than the liquid in the following tanks. Gas was gradually released during travel through successive digesters and produced a condition which was quite striking in appearance. The scum level in each tank was lower than that in the preceding one. This gave a "staircase effect" with each "step" 12 to 18 inches in height. The condition gradually disappeared and clear supernatant water appeared in May.

The gas domes on the covered digesters were built about three feet higher than the roof. When the foaming occurred the domes became filled with scum-foam and spasmodic releases of trapped gas blew out the dome oil seals almost constantly. Also, on several occasions the sludge got into the gas lines and even as far as the gas meter. It was obvious from this that the domes would have to be raised in order to provide sufficient gas capacity and to prevent the sludge from reaching the gas lines. This was done in October, 1936. Each dome was made four feet higher and the gas outlets were placed at the top. [In starting digesters, time is the most successful corrective of foaming troubles. Initial foaming is practically unavoidable. The "patient" recovers and, thereafter, large dome space is of secondary import. Moral—"Let them foam."—ED.]

At the time that the domes were raised it was necessary to lower the sludge level several feet in order to do the work. Consequently a large volume of air was drawn into the covered digesters. Immediately after completion of the work foaming began again and the staircase effect re-appeared. Although the pH value remained around 7.3, foaming continued to run its course. The gravity of the sludge dropped below 0.6.

The temperature of the sludge dropped considerably during the period when the domes were being raised and this was probably the principal cause for temporary subsidence and recurrence of the foaming. And, possibly, the air drawn into the digesters may have disturbed the anaerobic digestion processes sufficiently to cause the upheaval. It required approximately six months for the "steps" to disappear this second time.

Heating coils are located on the walls of the covered digesters and a temperature of 85 deg. F. is maintained. Water heated in a boiler, burning sludge gas, is circulated through the coils.

Chemical Treatment

The crude sewage is treated with ferric chloride which is made by passing chlorine solution through scrap iron.

Ferric Chloride Production

The ferric chloride generator consists of three circular tanks, each twelve feet high and 36 inches in diameter, made of vitrified tile pipe. These are set in a row. The two end tanks are filled with the iron. Chlorine solution from two Wallace and Tiernan vacuum type chlorinators enters these tanks at the bottom and passes upward through the iron. The solution of *ferrous* chloride, leaving the top of the towers, passes to the bottom of the center tank. At this point additional chlorine is added to convert the *ferrous* chloride to *ferric* chloride. This solution then flows from the top of this tank into the sewage passing through the aero-mixing tank.

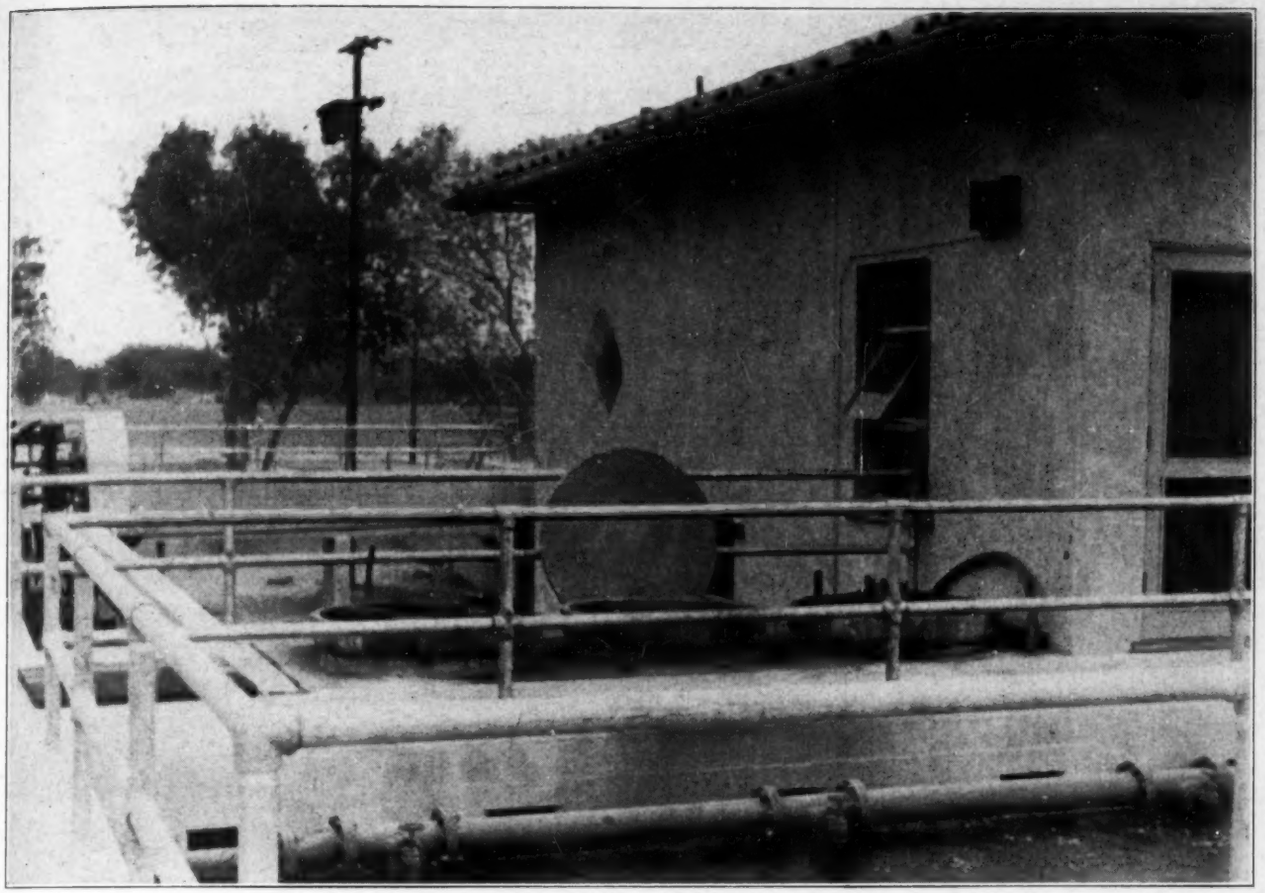
Disappointment

The iron originally used consisted of turnings and borings purchased from the railroad shops. From a theoretical standpoint, this iron seemed ideal, as it consisted of very small particles possessing a comparatively large surface area to react with the chlorine. The theory failed to work out, however, except for a short period of time.

We found that if one tank was filled with iron and a chlorine solution, known to be of uniform concentration and passing through at a constant rate, a drift in the solution (attack) of the iron scrap of the following character was obtained:

Time Elapsed from Start	Ferrous Iron, p.p.m.	Ferric Iron, p.p.m.	Total Iron, p.p.pm.
½ Hour	2,650	120	2,770
1½ Hours	2,300	120	2,420
2½ Hours	1,400	200	1,600
3½ Hours	400	750	1,150
4½ Hours	0	850	850
5½ Hours	0	700	700
8 Hours	0	650	650
24 Hours	0	550	550
48 Hours	0	500	500

By calculations, the iron concentration at the beginning (according to reaction $Fe + Cl_2 = FeCl_2$) came up to approximately the theoretical amount possible for a chlorine solution of the strength in use—i.e., about one pound of chlorine to forty gallons of water. But, it be-



Ferric Chloride Generating Towers (Center); Aero-Mixing Chamber (Foreground); Grit Chambers (Left); and Laboratory, Compressor, Chlorinator House, El Paso, Texas

gan to drop rapidly, until, after 4½ hours of service, all ferrous iron disappeared and the total iron in solution dropped to 500 ppm. (or lower) after two days.

It was then found that, when the flow of the chlorine solution was stopped, a tremendous amount of gas boiled out of the tank for about ten minutes. After the turbulence subsided the chlorine-water flow was again started and the iron content of the solution rose rapidly to 2,000 ppm. or more, only to begin dropping again within a short time. The flow of chlorine-water was stopped and again the evolution of gas took place.

Correcting the Trouble

When chlorine is put into solution and brought in contact with iron a number of things take place. One of these is the production of hydrogen. This gas, as we see it, is responsible for the falling off of the rate of attack by the chlorine and, thereby, the iron content in the solution. What seems to happen is that the very fine film (bubbles) of hydrogen gas (negatively charged) clings to the particles of iron (positively charged), producing a film which prevents the chlorine from coming in contact with the iron. Consequently, much of the chlorine passes through without getting a chance to react. The force of the water current, slight though it is, seems sufficient to hold the hydrogen against the iron, because as soon as the flow is stopped the hydrogen is released rapidly. The immediate increase in iron after the gas is released seems to substantiate the idea.

[The author's explanation fits in with the theory explaining the protective effect of the all-important hydrogen film on metal surfaces in other forms of corrosion.—ED.]

Stirring the iron with a bar also resulted in a release of the gas. The production of the gas film was so rapid, however, that unless the gas was removed every hour, or even more often, it was impossible to get a solution of uniform strength. This fact made proper treatment control difficult.

Various schemes for the release of the gas were considered, but none were successful until we tried a mixture of used tin cans with the iron borings. These were placed in alternate layers a foot or two thick. This brought about a decided improvement. The principal effect of the cans, attacked rather slowly by the chlorine, seems to prevent film accumulation from the hydrogen formed, thus allowing the chlorine increased access to the borings. The result has been an iron solution of satisfactory and uniform strength at all times. Variations in the rate of chlorine water feed have only a small effect on the concentration of the iron. We can therefore vary the chlorine dosage in proportion to the sewage flow and still produce a ferric chloride solution of known strength and desired quantities at all times. By merely changing the rates of chlorine feed the dosage of iron changes in proportion to the theory—$Fe + Cl_2 = FeCl_2$—the ferrous iron being raised to ferric in the central tower. Stirring is no longer necessary, because the hydrogen is released continuously and an equilibrium is maintained.

Iron Dosages—Results—Costs

The sewage is treated with approximately 25 pounds of iron (Fe) per M.G.—equivalent to 72 pounds of ferric chloride ($FeCl_3$). This dosage is much lower than that used in most other plants employing chemical coagulation. A study of the literature indicates that dosages of from 75 to 125 pounds of iron per million gallons,

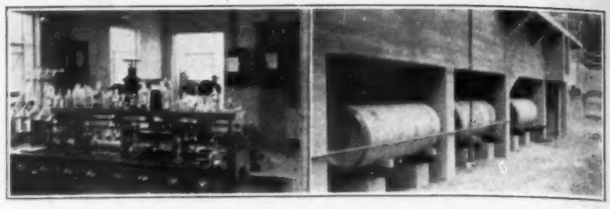
corresponding to 216 to 360 pounds of ferric chloride per million gallons, are commonly used.

Plants using these quantities of iron obtain about a 90 per cent reduction in suspended solids and about 75 per cent reduction in 5-day BOD. Assuming, for comparison, that $FeCl_3$ costs 4c per pound, the chemical cost runs from $8.00 to $14.50 per million gallons. Assuming further that the raw sewage averages 250 ppm. suspended solids and 225 ppm. BOD. we find that the cost is from $4.25 to $7.75 per 1,000 pounds of suspended solids removed and from $5.70 to $10.35 per 1,000 pounds BOD. removed.

At El Paso, 84 per cent of the suspended solids are removed and there is a 64 per cent reduction in BOD. Using the figures assumed in the preceding paragraph, our cost is $1.65 per thousand pounds suspended solids and $2.40 per 1,000 pounds BOD. removed. The actual data for El Paso from May, 1936, through June, 1937, are shown in Table I.

"At 4c per pound, which is our cost of production of ferric chloride, the above removals have been made at an average cost of $1.21 per 1,000 pounds suspended solids and $1.89 per 1,000 pounds BOD.

"Since ferric chloride delivered in El Paso would cost us around 10c to 12c per pound, the saving made by producing our own ferric chloride is therefore an appreciable item."



A Corner of the Laboratory and Arrangement of Ton-Chlorine Containers in Service

portion of material responsible for the BOD. One method of measurement used has been to determine the BOD. of the filtrate obtained from suspended solids determinations. While only a limited number of analyses have been made so far, the results obtained have been consistent. They show, that when ferric chloride is used there is a small but definite decrease in the true soluble BOD. Further, when no coagulant is used there is a slight increase in BOD. during passage through the tanks. These results indicate that while the main benefit of chemical treatment results from flocculation and sedimentation of the non-settleable suspended portions, the soluble component of sewage is also affected by the oxidizing salt.

A $30,000 WPA project at the plant is nearing completion at the time of writing. This includes construction of eight sludge beds, each 300 feet long by 50 feet wide, which have been completed and are now in use, and landscaping of the grounds. Eighteen inches of dirt has been placed on top of the covered digestion tanks and grass planted thereon.

The treatment plant was remodeled at a cost of approximately $110,000 as part of a $400,000 PWA project, that also included construction of new sewer lines and the Val Verde pumping station.

Plans for remodeling the plant into a chemical precipitation plant were made by Black & Veatch of Kansas City, Mo.

TABLE I—SUSPENDED SOLIDS AND BOD. REDUCTIONS—EL PASO, TEXAS

	1936							1937						
Suspended Solids—	May	June	July	Aug.	Sept.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	Avg.
Raw sewage	350	287	338	294	292	354	356	351	362	419	358	342	309	339
Effluent	48	45	55	53	46	75	66	54	60	54	51	52	48	54
Per cent removal	86	85	84	82	84	79	82	85	84	87	86	85	85	84.0
B. O. D.														
Raw sewage	...	...	288	270	245	248	270	327	...	291	345	319	270	287
Effluent	...	...	123	116	79	110	107	88	...	91	114	123	94	104
Per cent removal	...	...	57	58	68	56	60	73	...	69	67	62	65	63.8

Although there are few industrial wastes present, the sewage at El Paso is quite strong, as can be seen from the figures in the table—explained by the low per capita water consumption. Consequently, the effluent (even with the reductions mentioned) runs fairly high in BOD. The volume of dilution water in the Rio Grande is sufficient, however, to furnish the oxygen required without a serious decrease in the per cent of oxygen saturation in the river.

The problem of treatment differs in each community The figures above seem to indicate, nevertheless, that while a degree of purification such as is obtained at El Paso is done at a very low cost, attempts to obtain : relatively slight increase in results is achieved only at a disproportionately higher chemical cost. Our experience indicates that if the points of optimum efficiency and economy can be found, and treatment is kept adjusted between such limits, reasonable results are attainable at a reasonable cost.

Effect of $FeCl_3$ as Oxidizing Agent

The writer has been attempting to determine the effect if any, that ferric chloride has upon the *soluble*

Drive Mechanisms and Settling Tank, Converted from Three Old Units

▼

Tom Amiss, New Chairman Southwest Section

Tom L. Amiss

The Southwest Section of A. W.W.A. at its annual meeting in Galveston, Texas, October 21st, elected Thomas L. Amiss as Chairman of the Section.

Mr. Amiss is Superintendent of Water and Sewerage at Shreveport, La. He has long been an active member of A.W. W.A. and regularly attends its conventions. In Buffalo in June he was elected Vice-Chairman of the Plant Management Division of A.W.W.A. Those who know "Smiling-Tom Amiss" realize why everybody in Shreveport knows, and are boosters for, their Water Works Superintendent.

The New Sewage Works of Leominster, Mass.—From the Digesters.

NEW ENGLAND SEWAGE WORKS ASSN.

Features Practical Operation at Worcester Meeting.

By CHARLES L. POOL*

THE 9th annual get-together of New England sewage works operators and engineers revolved about a hub at Worcester on Oct. 1st and 2nd. Swapping of practical knowledge was the keynote; brief and snappy contributions, by "the many", proving more stimulating and valuable than presentation of a few heavy topics by a handful of "high-brows" could have done. The official registration of men was 114—attendance about 130.

Veteran sanitary engineer "Steve" Gage set the pace with brevity in his presidential welcome, proceeding forthwith to business. (The same Gage who paused in an address a few years ago only long enough to say, "Gentlemen, this must be an earthquake."—Ed.)

Joint Meeting of N. E. and N. Y. Ass'ns Planned

Secretary-Treas. F. W. Gilcreas reported a 17 member gain during the year and total membership of 139. With a balance of $473 in bank the treasury was in good shape.

Hartford was chosen as the meeting place where New England will return the hospitality of the New York State Assn. in 1935 at Schenectady, through another joint meeting of the two associations scheduled for October, 1938, in the "Insurance City," where the new sewage treatment plant of Hartford will be ready as an example of public health insurance.

Officers—1938

The following officers were elected for 1938:

President—John H. Brooks, Supt. of Sewage, Worcester, Mass.

Vice Pres.—Leroy Van Kleeck, San. Engr., State Dept. Health, Hartford, Conn.

Secy.-Treas.—F. W. Gilcreas, Chemist, State Dept. Health, Albany, N. Y.

Directors—Arthur D. Weston, Ch. Engr., State Dept. Health, Boston; Frank L. Flood, Engr., Metcalf, & Eddy Engrs., Boston; Stephen DeM. Gage, Consulting Engr.-Chemist, Providence, R. I.

A Two-Mayor Luncheon

Luncheon the first day was a "two-mayor" affair at which the mayors of Worcester and Leominster both spoke. At the head table was a guest from far off Australia—E. F. Borrie, Sewerage Engineer of Melbourne—who President Gage introduced. Mr. Borrie explained that he was here to learn what he could of American progress and its modern methods of sewage disposal.

Inspection Trip

Following luncheon the first day, a trip was made to the recently completed treatment plant of Leominster, Mass., which was constructed as a WPA project, interestingly from salvaged materials including lumber, bricks, some steel, and stone from an old sprinkling filter. The plant was designed by Metcalf and Eddy and a brief description of it was given during the meeting by Frank L. Flood of this firm, who had been resident engineer on the project. In brief, the plant will provide activated sludge treatment and separate digestion of sludges, dewatered on sand beds. Design capacity is for 25,000 population and 2 M.G.D. flow.

Following this, the new water filtration plant of Leominster (also a WPA project) was visited. Then, to Fitchburg to visit one of America's oldest, best known and best behaved Imhoff-Tank-Sprinkling Filter plants. For a minute, out of respect for the designer of this plant, on which he wrote medal winning papers, the visitors stood with heads uncovered in memory of the late Harrison P. Eddy.

Entertainment

The evening was given over to the annual banquet, after which followed high class entertainment by a versatile family of Worcester musicians and a comedian (black-face) extraordinary. Far above par, John Brooks and his committee on entertainment were congratulated by those present.

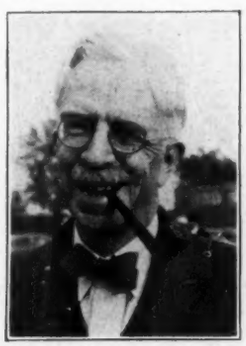
Utilization of Sludge: A Symposium

The Technical program was opened by R. S. LANPHEAR, Supervising Chemist, Worcester Sewer Dept., who described Worcester's disposal of air-dried Imhoff

Water Works and Sewerage—November, 1937

*Sanitary Engineer, State Department of Health, Providence, Rhode Island.

John H. Brooks, Jr. Incoming President.



Stephen DeM. Gage, Retiring President.

F. W. Gilcreas
Albany, New York
Secretary-Treasurer, N.E.S.W.A.

E. F. Borrie
(Honored Guest)
Engr. of Sewerage
Melbourne, Australia.

tank sludge which is removed from underdrained sand beds and deposited as fill, except for such small portions as farmers and gardeners take away in autos. Worcester's annual expense for sludge disposal is nearly $15,000, the 15,000 cu. yds. of sludge a year costing 85 cts. to $1.00 per cu. yd. for disposal. Mr. Lanphear has checked the use of the sludge and finds it good on grass in orchards and in market gardening use. A market gardener attending the meeting, was asked to report his experience. He said that after a year's use he could see no difference, that it runs acid and must be limed heavily to prevent harm. Mr. Lanphear's figures indicated Worcester sludge too poor in fertilizer value to attract farmers to truck it away.

GUY E. GRIFFIN, Superintendent of Treatment Works, Greenwich, Conn., reported on the use of sludge from domestic sewage from septic tanks, separate sludge digestion tanks, and Imhoff tanks at the Greenwich plants. Sludge varying from 2 per cent solids for the septic tanks to 10 per cent solids for separately digested sludge is well dried on sand beds and automatically shredded and loaded. The final product contains 50 to 60 per cent organic matter, 2.1 to 3.6 per cent nitrogen, 0.5 to 1 per cent phosphates and 3 to 5 per cent fat. Mr. Griffin experimented with sludge on various crops, comparing it with commercial and other prepared fertilizers and mixtures. Plain sludge gave the best results on the whole, dahlias, peas, beans, tomatoes, and grass doing well. Users take all the sludge year after year. Mr. Griffin considers the sludge has a soil conditioning and fertilizing value at least comparable to ordinary manures and that it is less odorous. Its value on a nitrogen basis is 50 cents per cu. yd., but shredding and removal by belt-conveyor costs 90 cents.

J. W. BUGBEE, Supt. Sewage Disposal, Providence, R. I., told of the disposal of 27 dry tons of sewage solids daily at the Providence activated sludge plant. Providence sludge has not been popularized as fertilizer, but is dewatered on filter presses and dumped into 120 feet of salt water where it has caused no nuisance in 30 years. To mixed sludge from the new plant, containing 5 to 7 per cent solids, of which two-thirds is a raw sludge and one-third (dry basis) is from the activated process, hydrated lime equivalent to 3½ per cent of the sewage solids and ferric chloride equivalent to 5 per cent of the sewage solids are added and mixed. Sludge with a pH of 6.0 to 6.4 is reduced to a cake with 27 to 30 per cent solids by air pressure of 40 lbs. per sq. in. in long used plate type filter presses. A scow dumps the 700 tons of cake weekly and an average of 50 tons of solids from screens and detritors. The presses promised economy in 1895-1900, obviating the purchase of a sea-worthy steamer for chemically precipitated sludge. The economy of continuing the use of the presses has been re-estimated at times. With repairs needed, and difficulty in obtaining labor for the disagreeable tasks of operating the plate presses, the question is up again at the present time, involving a study of sowing out wet sludge vs. vacuum filtration and incineration.

Disposal per ton of dry solids costs $.60 for drawing and pumping, $2.64 for conditioning, $2.58 for pressing, and $1.85 for carting, scow loading, and dumping. Total, $7.67 per ton of dry solids. The cost averages $5.76 per m.g. of sewage treated.

P. C. MARTZELL, Greenwich operator, asked whether the Park Commissioners could not be educated to take the bulk of the sludge as at Greenwich, to which Mr. Bugbee replied that this has been tried without much success. The sludge being undigested was quite different from that of Greenwich.

CHESTER G. PROUDMAN, Supt. of Sewerage, New Canaan, Conn., exhibited fine specimens of sludge nourished Zinias and discussed some interesting experiments on the practical use of digested sludge from his activated sludge plant. (The New Canaan plant was described in WATER WORKS AND SEWERAGE, Sept., 1932, Vol. 79, p. 326.—Ed.) Sludge containing 97 per cent moisture, is dried for 10-30 days, giving 9 dry cu. yds. a month to store in piles, where it is donated to takers. On the dry basis, volatile matter runs 70 per cent, nitrogen 2.4 per cent and over, and P_2OS 1.75 per cent. For five years Mr. Proudman has tested this dry sludge and also liquid sludge on various crops, from which he has acquired a strong preference for the latter. The dry sludge has been good for corn, rhubarb, etc., but the unshredded product has been known to ruin lawns, after a profuse growth has appeared in the spring. He noted that often the grass will start well but dies later in the summer. Mr. Proudman has sold liquid sludge (delivered) for one cent a gallon at a profit. His only limit to a successful venture seems to be the lack of facilities for handling.

L. H. ENSLOW was interested and pointed out that the use of liquid sludge seemed a sound practice and high economy. It could be distributed uniformly and the quick acting ammonia salts in the liquid, plus the sustained effects from the solid portions, provided good fertilizing—was the basis of fertilizer compounding. (For many years, liquid sludge has been sought after by market gardeners in the area surrounding the Baltimore, Md., plant.—Ed.)

PAUL V. FLEMING, Chief Operator, North Adams, Mass., said that he gets rid of all his sludge at 50 cents a load but, after hearing the discussions, thought he would go back to a dollar.

H. G. A. GILES, Asst. Engr. Conn. State Dept. of

Wm. R. Copeland, Chief Engr., State Water Comm., Hartford, Conn.; LeRoy Van Kleeck, St. Engr., State Dept. Health; Herbert Allen, Supt. Sewage Treatment Works, Fitchburg, Mass.

(1) R. S. Lanphear, Chemist Sewer Dept., Worcester; (2) Gil Pratt, Veteran "W&T" Sales Engineer, Boston; (3) Stuart Coburn, Chief Chemist, Metcalf & Eddy, Engrs., Boston; (4) Geo. B. Gascoigne, Pres., Geo. B. Gascoigne Associates, New York and Cleveland; (5) J. W. Merwin, Sales Engr., Chain Belt Co., Boston; (6) W. E. Haywood, Sales Engr., Pittsburgh Meter and Merco-Nordstrom Valve Co.; (7) C. Copley, Supt. Sewerage, New Haven, Conn.

Health, told of the interesting practice being demonstrated at the New Britain, Conn., plant. Mold is inoculated into sludge which a belt turns over daily in compartments on a 10 day cycle. Temperatures produced by the mold growth have exceeded 160° though of course they are usually lower. It is claimed that the heating process reduces weeds and seeds and gives a final product with only 24-40 per cent moisture. Low temperatures in practice are probably due to poor seeding. It was reported to him that similarly processed sludge sells for $5 to $10 a ton in a couple of southern cities and is delivered in a usable loose condition, as a soil conditioner. The sludge at New Britain is from the Guggenheim process of chemical precipitation aided by air blowing.

CHESTER G. WIGLEY, Royer Foundry & Machine Co., Atlantic City, N. J., recommended that sludge be marketed as a "compost" and not as "fertilizer" so as to avoid requirements in agricultural laws regulating the sale of true fertilizers. He considered sludge of little value as a fertilizer, but to have a worthy place in agricultural economy. Mr. Wigley told of the sale of ground sludge at the good price of $18 to $20 a ton on a dry basis. Southern conditions, he pointed out, are different in that one-crop practice (tobacco) puts a premium on sludge in places. Sludge is a leaf crop developer above all else. Beach sand with ground sludge mixed in produced fine potato vines but only puny potatoes; and corn failed to produce good ears. Cabbage, beans, etc., gave a splendid yield the first year. However, after the third year the root crops improved so that Mr. Wigley thinks that long-time experiments are necessary to secure the true value of sludges, because slowly realized fertilizer value seems to be there. Further, instruction in the proper and skillful agricultural use of sludge may pay the sewage worker and the user.

HERBERT B. ALLEN, Supt. of Treatment Works, Fitchburg Mass., spoke of his accumulated pile of 5 year old sludge, now almost reduced back to loam, which at last he hopes will find a use on a cemetery.

Inside Story of Lubrication

C. J. COPLEY, Socony-Vacuum Oil Co., New York, gave a spirited general talk on lubrication of mechanical equipment such as is found at sewage treatment plants. This was continued the next day at a round table discussion. Lubrication is usually helter-skelter and the result is the undoing of great pains taken in design. In evaluating oils he said that analysis, beyond a few simple tests revealing viscosity and the like, had no real significance. Oil "performance" was the real test and the reliability of the purveyor had much of significance in securing lubricating service.

Three fundamental classifications of lubrication (1) Bearings, (2) Gears, and (3) Cylinders were briefly discussed by Mr. Copley. Bearings are lifted off their housing by a film of oil. The heavier the oil the thicker the film. An example of importance in selection of lubricant was given in connection with a New York elevator system, the cab being hung by a wire rope over a drum on two bearings and operated at modern top speeds. In this case a lighter bodied oil reduced viscosity-drag 50 per cent and saved $94 a month in the power bill on a single elevator.

Cylinders are provided with tight piston rings to trap the power. A too viscous (heavy) oil between ring and cylinder wall causes lubrication failure and scarred cylinder walls. Some oil must get past the piston rings and is burned with the fuel—therefore, the selection of a clean burning oil is a prime factor in combustion engines.

Concerning gears, a major point was that lubrication must supply cushioning at point or line of contact where high friction pressure is created. In modern gearing lubrication has had to improve to prevent heat-welding of the metal meeting at high speeds. For this purpose sulphur compounds are added to the lubricant.

To buy oil today by specification is extremely complicated. The tests are numerous, gravity, flash point, fire point, viscosity, pour point, carbon test, steam emulsion tests, etc., but they do not tell us how to specify what we want most in a lubricant—namely, film strength and durability. Most lubrication ads mean nothing and safety demanded that one should rely on a concern with experts to select an oil which by their experience will do the particular job. Call in engineers on lubrication, follow their advice, and use oil as prescribed. That was the best answer he knew to the question "What oil should we use?"

Asked, what lubricating care chains under water required, Mr. Copley noted that chains were of two types, (1) those which slip over a sprocket, and (2)

Guy E. Griffin, Supt. Sewage Treatment, Greenwich, Conn.; Julius W. Bugbee, Supt. Sewage Treatment, Providence, R. I.; Frank L. Flood, Engr., Metcalf & Eddy, Boston, Mass.

At the Leominster and Fitchburg Treating Plants

(1) Prof. Gordon Fair (Harvard) and Chester Proudman, Supt. Sewerage, New Canaan, Conn.; (2) At the Leominster Plant; (3) Sludge Disintegrator at Work at the Fitchburg Plant; (4) Another Group at Leominster; (5) Jim Ferris, Sales Engr., Electro-Bleaching Gas Co., New York; and Frank Roe, Mgr. San. Sales, The Carborundum Company, Niagara Falls.

those which have bearings in the chain. With chains in general it is desirable to keep them as free as possible, consequently a light lubricant is indicated. For underwater bearings it depends on whether the type is (1) that in which water is wanted in the bearings or (2) that in which water is not wanted. Grease, consisting of oil and soap, when made with a soda soap is lather forming and useful in the first type, and when made with a lime soap is water repellent and useful in the second.

Mr. Copley continued his informative discussion, noting that lard and fish oil added to oil, for instance, keep piston films from being steamed free from oil. A poor grease subjected to high temperatures suffers separation of oil from soap. The soap oxidizes and the end result is a burnt bearing. Anti-friction bearings, which are increasing in use, are theoretically easy to lubricate but, in fact, difficult. In ball bearings, the guide that keeps the ball in place needs lubrication and is *not* simple, the operator tends to over-lubricate through mistaken zeal and creates a heating condition. It is important to avoid this and now a set-gun is on the market to dose the desired amount.

MR. VAN KLEECK'S suggestion that such precautions ability of stick, is the desired quality here, and these lubricants have been much used where other products might be subject to washing off in heavy weather.

GEORGE B. GASCOIGNE, Consulting Engineer, Cleveland, Ohio, told of an innovation at the large plant under his supervision where a young engineer is being especially trained to oversee all lubricating details of great variety, but wondered what smaller plants could do, say a plant with a budget of $25,000 a year and $250 perhaps for lubricants. Who would answer for proper routine lubrication, the manufacturer of machinery or the concern furnishing the lubricant? Copley foresaw the avalanche of discussion to follow and advised teamwork between manufacturer, lubricator, and the operator. Gascoigne asked whether a lubrication engineer or a concern should be specified by the manufacturer and Agar wanted to know if oil companies gave this advice. Copley replied that competition had made oil companies sell lubrication these days, not merely lubricants. Giles commented on the increase in sewage works equipment to a point where the engineering problem is complex and suggested, with Copley's confirmation, that the manufacturer should give the operator the data on the care of his equipment and that

(1) Mark B. Owen, Vice Pres., Nichols Engrg. & Research Corp., New York City; (2) Paul V. Fleming, Chief Operator, Sewage Works, North Adams, Mass.; (3) W. A. Craig, Sales Engr., Link-Belt Co., Philadelphia, Pa.; (4) Samuel Ellsworth, Consulting Engr., Boston; (5) Robt. S. Burr, Service Engr., American Brass Co., Waterbury, Conn.; (6) Edw. Wright, Engr., State Dept. Health, Boston; (7) Lee Williamson, Engr., Guggenheim Bros., New York City.

as wiping grit off the end of an alemite gun might be worth introducing into the discussion merely served as a torch to set Copley off on a tirade on cleanliness as the sine qua non of lubrication, admitting, however, that a virtue of pressure lubrication systems is their ability to force dirt out of bearings.

MR. AGAR inquired whether there was much trouble with lubrication of bull-wheels in digestion tanks. Mr. Copley disclaimed familiarity with the terminology and mechanical details of sewage treatment equipment but added that from what he might imagine their function to be, application of lubricant would be apt to be wasteful and mentioned the class of fluid viscalite lubricants which are "heavies" cut back with naphtha and which have been successful lately. The light naphtha goes off and leaves the desired consistency. Tackiness, the the operator should insist upon having it. Mr. Van Kleeck (Leader), in closing the discussion, recalled the large amount of equipment located outdoors and exposed. He recognized that the solution would have to wait until there was a formula to show at what point it is economical for the small plant to purchase expert service on lubrication.

Gas and Oil Heating Equipment

The topic—"Gas and Oil Heating Equipment," was opened by L. L. Langford, Sales Engr., Pacific Flush Tank Co.

Mr. Langford stressed the need of knowledge of capacities and characteristics of equipment, noting that many operators do not know the gas holding capacities or the pressure limitations of their units. Changes in sewage plant personnel is a disturbing factor, but manu-

facturers try to specify and outline important steps. Points needing special consideration for proper design and care of separate sludge digestion systems are whether single or multiple gas-domes are best; whether the necessary relief devices are installed and are in working order; whether provision has been made to quickly release gas at the dome and whether this is desirable at this point of the system or elsewhere.

As to gas piping, operators should satisfy themselves that it is properly connected to the dome, whether there is a possibility of sludge or scum collecting in it, in vertical bends or horizontal stretches; whether the size is proper and whether the pipes are laid in a fill or whether firm and protected from accident and laid on correct pitch and grade. Whether under-road crossings are safe and whether temporary drives endanger the pipes. Whether there is any danger of freezing; gas does not readily freeze but condensed water becomes great at times. Other questions to which operators should get satisfactory answers are whether there is an adequate condensate trap where the lines enter buildings, and whether the gas meters are big enough, and are fed by big enough lines. Does the meter register correctly? Are maximum flows provided for? Is there a safety by-pass around the meter? Is there a way to detect pressure loss through the meter; for example, if it becomes filled with water?

Proceeding in order from digester to boiler: Are flame traps of the water seal type or of the dry type? The former generally have greater capacity limitations. Are water seals being maintained? Is a fresh water supply provided so that the seal will not depend entirely on supply of condensate? Is the drain from the seal discharged *outside* and vented to atmosphere? Is the seal drained into a building where there may be a flame burning? If the dry type, is it self-indicating as to whether it is in operating condition? The dry type, he explained, usually shuts off the gas line by thermal link set-off.

Mr. Langford stressed the importance of cleaning of equipment, especially the wet-seal type. Pressure losses, if determined, will show when lines are free. For the purpose, two or three gages in a line are desirable. The functioning and adjustment of relief traps, both wet and dry type, should be understood. They should not be in chimneys and should not be inaccessible. Pilot lines are often too small in diameter and inadequately pitched.

MR. AGAR questioned whether the materials used for the gas piping had been worked out to enable the best choice to be made, and predicted that failures from old piping, especially in lines from dome to building, would begin to appear in a few years; and with attendant explosion hazards.

MR. LANGFORD suggested that a U-gage valve was indicated for installation in these lines to reveal tendencies towards failures. Mr. Giles said he understood that cast iron pipes were as resistant to corrosion as any, and are now available in the smaller sizes, even down to the 1½ inch diameter. Mr. Leslie A. Davis, City Engineer, Danbury, Conn., reported that a 3 in. coated cast iron pipe was used at his plant.

The question of the use of sludge gas and city gas in the same burner was raised by Mr. Griffin. Mr. Agar stated that a burner, designed or regulated for sludge gas, will burn city gas but the reverse is not true.

MR. PROUDMAN thought that explosion hazards made it unwise to confine too much apparatus in one building but Paul Martzell, with his unfailing originality, considered this no panacea since "you might find yourself in the one unit skyward bent." Mr. Van Kleeck felt that a gas and oil combination would be undesirable where automatic control was depended upon, to the extent that its uncertainty at this stage makes manual control safer for such a combination.

MR. GILES, in reference to a point raised by Mr. Langford, suggested the use of two pressure reducing valves in steps, to avoid the blowing out of seals, or, else, a dry flame trap of greater pressure range.

Two separate boilers offer a distinct advantage, Mr. Langford continued, and boiler water temperatures should be kept up to at least 170° to minimize if not prevent *serious* condensation troubles. To prevent chimney and jacket troubles, proper tempering valves to produce blended water before fed to coils are warranted. He cautioned against sending water too hot to coils. Since 130° water is safe and 140° water is not known definitely to be safe, the 130° temperature is indicated for a working maximum.

Mr. Agar reminded that the rates of flow in a circulation system are important because of the heat limitations, and Langford raised the point whether, in case of need, too low a rate might not be better than one too high. Agar added (Langford agreed) that a control by-pass around the water meter is important in this connection.

(1) *Chas. L. Pool, Engr., State Dept. of Health, Providence;* (2) *John C. Finn, U. S. Pipe & Foundry Co., Boston;* (3) *C. G. Wigley, Royer Foundry & Mach. Co., Atlantic City, N. J.;* (4) *K. E. Foote, Sewerage Engr., New Haven, Conn.;* (5) *Howard Pardee, Pres., Pardee Engrg. Co., New York City;* (6) *Enos C. Flood*, Supt. Sewerage, Framingham, Mass.;* (7) *Gordon M. Fair, Prof. of Sanitary Engineering, Harvard University.*
(**Mr. Flood, Father of Frank Flood, Has Served on Framingham's Sewerage Commission for 23 Years.*)

Sewage Pumps

WM. DAWSON, Fairbanks Morse Co., in handling the topic—"Care and Repair of Mechanical Equipment"—presented as complete a discussion on the care of pumps as the remaining time permitted. He pointed out that the prime essential in sewage pumping is to select the right pump for the job; thereafter, its correct installation, and care. Vibration troubles in sewage pumps had

been traced to clogging, and resultant trouble with the bearings.

Single suction pumps allow sewage to enter impellers without catching. For this reason, 90 per cent of sewage pumps are of the solid volute type. Side-suction, horizontal split-casing pumps are a desirable type, being easy to get at without disturbance of suction or discharge. Although the split casing reduces the rated efficiency, the *real* efficiency is the continuity of pumping without clogging rather than merely the power consumption per delivered load. Mr. Dawson then outlined features of Fairbanks Morse pumps.

Raw-hide packing for stuffing boxes, being slippery and not easily abraded, was recommended. It is well to pack two to three times a year, staggering the cuts and drawing nuts only finger tight. In repacking, he advocated complete renewal of packing, avoiding the addition of new to old.

Realizing that vertical-shaft pumps have their place, Mr. Dawson emphasized the necessity of care in shaft alignment. He warned that flexible couplings *do not* adjust for misalignment. Sealed bearings were recommended in preference to Alemite connections. When bearings run hot, a flush-out and repacking with *less* grease will cure the trouble in 75 out of 100 cases. Over-greasing is a common fault, and grease should be flushed out twice a year in any event.

MR. VAN KLEECK, questioned whether the Fairbanks-Morse water cooling for stuffing boxes had been designed to overcome cross connections between drinking water lines and sewage pumps such as the Nash Co. has provided with small elevated tanks. Mr. Dawson noted that, in addition to avoidance of cross connections, such tanks reduced losses from high pressure leakage.

S. E. KAPPE of the Chicago Pump Co. spoke of research being done on impellers, both the open and closed type. Wearing rings are good when new but efficiencies drop with age. He scored the trend in the design of wet wells towards the circular type. The rotating movement of the sewage does not avoid settling enough to compensate for difficulties resulting from the stringing out of filaments. It is the stringing out of rags, rope, and the like, that causes the worst clogging by winding and matting. Mr. Kappe, in stating that water seals are generally more satisfactory than grease seals, agreed that no physical cross connection should be allowed with sewage pumps under any circumstance.

MR. GILES asked whether air cushions were necessary on both the suction and discharge sides of plunger-type sludge pumps, having noticed knocking with higher rates of pumping. J. W. Van Atta, Sales Mgr., Ralph B. Carter Co., New York City, stated that ferric chloride would sometimes cause foaming in the air chamber with resultant noise, and recommended the addition of a "pound eliminator" where knocking was serious.

MR. MARTZELL vigorously questioned the efficacy of rawhide for packing since he could not keep it from being forced out of his packings. Mr. Dawson replied that no trouble need be anticipated with the usual 60 to 75 lb. pressure at sewage plants. It proved that Mr. Martzell had 90 lbs. pressure.

Exhibits

The following 17 manufacturers had exhibit booths at the meeting: American Brass Co., Chain Belt Co., Chicago Pump Co., Cinder Concrete Units, Inc., Ivertol Co., Johns-Manville Co., Merco-Nordstrom Valve Co., Pardee Engineering Co., Pittsburgh Equitable Meter Co., Royer Foundry & Machine Co., Trohn's Supplies, Inc., U. S. Pipe & Foundry Co., Wailes Dove-Hermiston Corp., W. & L. E. Gurley, Wallace & Tiernan Co.

"The End of the Trail" (In Memoriam)

This might as well be a picture without words. So that we might remember Treatment Trailer No. 1, Jeff Corydon has sent us this sad picture of his trailer which took some rough treatment from a Virginia telegraph pole just north of Roanoke.

It seems that Mr. Trailer decided to unhitch from

"The End of the Trail"

the towing car enroute to Galveston, Tex., at 55 m.p.h. Getting mad because it couldn't catch up with Jeff, it just dashed its brains out against a convenient telegraph pole. As a matter of history, and warning to water works and sewerage trailer enthusiasts (and "in memoriam" to Proportioneers' Treatment Trailer No. 1) Jeff has agreed that we print this record under the caption *"The End of the Trail"*—but, he says, that he's going to know lots more about hitches before launching Treatment Trailer No. 2.

▼

Watson and Watson Both John D.—Both of England

(A Correction)

From Mr. John D. Watson of England came an article on "Sewer Flushing," with others promised to follow pertaining to economies in sewer construction and utilization of sludge gas in power development at British plants.

The introductory article, "Sewer Flushing," appeared in our August issue. With it, editorial reference was made to the fact that the author's latest achievement had been the design of the gigantic 690 M.G.D. Mogden Sewage Treatment Works near London.

From Mr. John D., we have received the following advice: "I was very pleased with the presentation of my article in the August issue, but in your opening paragraph you unfortunately confused me with a gentleman of the same name. I myself have not had any direct connection with the Mogden works, having recently retired from a Government post. However, I got into communication with the other Mr. Watson and he appreciated the fact that the error was quite excusable."

Well, we can but apologize for the mixing of the John D. Watsons—both of England, both engineers, both in the sewerage field. Now, we are wondering if—like "Ike and Mike" there is any resemblance. Such is the life of an editor!

THE 57TH CONVENTION OF N.E.W.W.A.

(Part 2 —Concluding Installment)

IN OUR October issue is to be found the first installment of this report covering the 57th Annual Convention of the New England Water Works Association, held at Maine's long-famed resort and watering place—Poland Spring Spa.

Although the spot was ideal for golfing and recreation, the deficiency in respect to meeting rooms, plus the call of the out-of-doors, made perceptible inroads on attendance at technical sessions. Particularly was this noticeable in respect to the Superintendent's Sessions, which are usually the best attended of any of N.E.W.W.A.'s sessions and bring forth a free flow of lively, interesting and valuable discussion. The arrangement of having the meeting room in a building removed from the hotel was to a measure responsible for the noticeable deficiency in technical meeting attendance. As an outing, the 1937 Convention was 100 per cent a success. As a technical meeting, such was not the case and by the same token the manufacturers' exhibits received secondary attention only. Play was in Maine's fall air, which had the quality of fine light wines, and the convention lacked nothing in enjoyableness to the many who will remember it long for that quality.

Lacking sufficient space to complete the reporting of proceedings of the technical sessions in our last issue, the accounts of the "Symposium on Gravel Packed Wells," and the "Round Tables" of the Superintendents and the Chemists, held on the closing day are here presented.

Symposium on Gravel Packed Wells

(PAUL F. HOWARD, *Leader*)

"Experiences With Low Velocity Gravel Packed Wells, by PAUL F. HOWARD, Whitman & Howard, Engrs., Boston, Mass.

Mr. Howard related experiences in water supply improvement at Attleboro, Cotuit and Harwich, Mass., involving the construction and development of gravel packed wells.

In the first instance (Attleboro) the existing 88 driven 2½-inch wells were connected to a common suction header. The unequal pull on these wells and extreme flow velocities (67 ft./min.) toward many of the strainers brought soluble iron into the wells in highly objectionable quantities. It was decided to put down three low velocity gravel packed wells (52 in. diam.; 22 ft. deep) into which the flow velocity would be but 2½ inches per min. For these wells the same field area was used after the iron bearing surface soil had been stripped and the well field equipped for flooding to augment the supply. Pumping tests, with and without flooding, showed a satisfactory water quality of less than 0.2 p.p.m. iron content and water yields in excess of predictions at low water table draw-down.

"Wheel-Horses"

Percy A. Shaw, Supt. Manchester, N. H. (Elected Vice President); Arthur C. King, Supt., Taunton, Mass. (Chairman Legislative Committee); Wm. B. Duffy, Supt., North Andover, Mass. (Chairman Finance Committee)

Malcolm Pirnie, Cons. Engr. New York City

Paul F. Howard, Cons. Engr. Boston

At Cotuit, four similar wells had been put down 30 ft., as a development of a new supply ample in quantity and most satisfactory in quality. Pumping at 500 gals./min. is by Diesel engine with gasoline engine as a standby, giving a combined capacity of 1,000 gal./min.

At Harwich the four 52-in. wells, put down 200 ft. apart, are essentially duplicates of the Cotuit wells and, like the latter, show a rapid recovery of draw-down after cessation of pumping. Pumping facilities are essentially the same as at Cotuit. Each well cost $2,000.

The three developments indicate the hazard of high velocity driven wells, as distinct from the slow velocity gravel-packed wells of greater diameter, which have proved dependable as to quantity and quality of water supply from the formations encountered.

"Gravel Packed Wells at Needham, Mass.," by BAYARD F. SNOW, President, X. Henry Goodnough, Inc., Engrs., Boston, Mass.

Mr. Snow, aided by moving pictures, reviewed the development of additional ground water supply for Needham, Mass., involving construction of a Layne & Bowler gravel packed well 93½ ft. deep, equipped with 50 ft. of screen. One well had yielded 4.5 m.g.d. with an 11-ft. draw-down. Mr. Snow told of the exhaustive investigation, study of ground reservoir area by test wells on 50-ft. centers, and eventually restricting well location within an area 100 ft. square. Specifications limited sand entry to 1 pint of sand per m.g. when pumped at rate of 2 m.g.d. He complimented Roger G. Oakman, Needham's Supt. of Water, for his initiative in getting the engineering survey authorized by the council, and his work on test well operation and keeping of records so essential in reaching decisions during the study.

MR. OAKMAN related his experiences in attempting to get the required appropriation in 1934 for the investigation. After having spent $2,000 on test wells alone, it "was a case of success or going to jail." He spoke of the value of the visual demonstrations of well pumping to the public. Operation of the new well (equipped with deep-well turbine, belt driven from a Diesel en-

Bayard F. Snow, Cons. Engr., Boston

Roger G. Oakman, Supt., Needham, Mass.

gine), since February, 1937, had produced on the average 0.5 m.g.d. and was good for twice that in continuous yield. No attendant remained at the station, there being six inspections, one being at 2 a. m. by the police. Automatic shutdown had been arranged for in case of failure of cooling water or excessive main pressures. Cost of Diesel pumping had varied between $7.25 and $8.00 per m.g.

"Additional Ground Water Supply for Woburn, Mass." by JOHN P. WENTWORTH, Metcalf & Eddy, Engrs., Boston, Mass.

Mr. Wentworth reviewed the history of the development of Woburn's water supply, the failure of driven wells and the success of four gravel packed wells over a period of five years, and now yielding but 0.2 m.g.d. less than the original output. In 1936 two new wells had been put down with 4.5-ft. outer casing, 36 in. intermediate casing of Armco iron and 24 in. inner casing, gravel packed between the 36 and 24 in. casings and concrete sealed between the outer and intermediate casings. The contract called for guarantee of quantity and quality of water over a period of one year. One well was equipped with a 7-stage Fairbanks-Morse deep well pump, subject to variable speed operation; the other with an 8-bowl Byron-Jackson pump. The water running from 75 to 100 parts of hardness, and low in iron content, was low in corrosiveness and pleasing to consumers.

CHARLES W. SHERMAN (Boston) emphasized the need of holding velocity of flow toward driven wells to the minimum, in order to keep down iron content—20 g.p.m. pumpage being the limit per well.

PERCY R. SANDERS (Concord, N. H.) related an interesting experience resulting in leaks on a lead jointed 20-in. main. Switching from surface water at 72 deg. F. to well water at 42 deg. F. had apparently created sufficient pipe contraction to cause joint leakage. Mr. Howard recalled a similar experience.

Experiences with Iron Coagulants

"Some Operating Experiences With Iron Coagulants," by MALCOLM PIRNIE, Consulting Engr., New York City.

Mr. Pirnie discussed the characteristics of the "newcomers" in the coagulant field—the iron compounds—their especial advantages, methods of storage, handling, feeding. Especially advantageous had ferric iron coagulants proved in the two extremes of pH range in water treatment, to wit: effective color removal in the acid range; for softening or iron and manganese removal in pH range 9 and above. In removal of silica, so desirable in boiler water treatment, especially effective had proved "Ferrisul"—a ferric sulphate, susceptible of ease in handling and storage, and now competitive in price with other coagulants.

Mr. Pirnie cited the benefits accruing after the change-over from filter alum to "chlorinated-copperas" and later to "Ferrisul" at the Providence, R. I., plant. The same results had continued to be realized with ferric-chloride, the iron content at consumers taps being actually lower (0.03 p.p.m.) during coagulation with iron salts than with filter alum. At the St. Petersburg, Fla., plant, in which partial softening is practiced, "Ferrisul" had served as the coagulant in a unique manner by adding it to 40 per cent of the raw water and lime to 60 per cent, and the two mixed thereafter. For the West Virginia Pulp & Paper Co. at North Charleston, S. C., an all-steel filter plant of 50 m.g.d. capacity, similar in design to that at St. Petersburg, was to employ "Ferrisul" as the coagulant. Studies had shown that a dosage of 2 gr./gal. at pH 4 effectively reduces the color of the water from 170 to 10 p.p.m. and removed silica in addition. At Piedmont, W. Va., where acid mine waters constitute the supply from the Potomac River, coagulation with alum and caustic soda had failed to remove manganese effectively. It was proposed to change to iron coagulation at pH 9 and employ up-flow coagula-

1. Ralph Shaw, Publicity Mgr. U. S. Cast Iron Pipe Co.; 2. Horace L. Clark, Supt. Sanford (Me.) Water District; 3. Chas. D. Cox, McWane Cast Iron Pipe Co., New York City; 4. Mark F. Croker, Supt., Newton, Mass.; 5. F. L. Hatch, Supt., Kittery (Me.) Water Distr.; 6. Col. W. H. Rockwell, President, Pittsburgh Equitable Meter Co.; 7. Thos. F. Kilroe, New England Representative, WATER WORKS AND SEWERAGE

Convention Committeemen

Exhibits—J. Herman Smith (Hersey Meter Co.). Sports—J. Wm. Wickwire (Edson Corporation). Entertainment—Horace J. Cook (Auburn Water Distr.)

tion and up-flow sedimentation, proven so effective at St. Petersburg. Again, at a small plant employing ferric-chloride, the rate of rise being 1.5 inches per minute or less, the up-flow principle had proved its worth.

Mr. Pirnie then described the removal of iron from well water supplies of Long Beach, N. Y., Stuart, Fla., and elsewhere, by contact beds of gravel. Involved was a mild aeration, with added coagulant, followed by flow upward through 9-ft. beds of gravel. On the gravel surfaces the oxidizing iron "plates out" at up-flow rates of 2 gal./sq. ft./min. Bed cleansing, when 3-ft. head loss is reached, consisted of opening a rapid dump valve producing a scour of 6 ft. per minute water drop through the bed. Upward wash was applied at a rate of 4 ft./min. vertical rise per minute once monthly. Too thorough aeration had resulted in precipitation of iron before reaching the gravel, and this defeated the mechanism of the plating out or purging process due to contact of soluble iron with iron hydrates in presence of dissolved oxygen. In essence it was a form of catalysis. Then was described the unique procedure at West Palm Beach, Fla., wherein an alkaline deep well water is added to the coagulated raw water to attain alkalinity adjustment and refinement in pH control, for most efficient floc production for color removal, and minimum filter troubles. Further, the successful adaptation of pH adjustment to 9.0 with lime, supplemented with ammonia-chlorine treatment, for corrosion control and suppression of taste complaints and iron pick-up due to organic matter degradation in remote parts of the distribution system.

Stuart E. Coburn, Chief Chemist, Metcalf and Eddy Engrs., Boston

Chas. L. Pool, Sanitary Engr., R. I. State Dept. Health, Providence

In the ensuing discussion it appeared that copperas (ferrous sulphate) could not be stored in the deep bins at Providence without caking resulting from the weight of the material. At Richmond, Va., and at other plants where chlorinated-copperas is produced, such difficulty had not been encountered with shallow bins. Especially was this the case where the copperas was being handled by the dustless air-veyor system from car-to-bin and bin-to-feed hopper. The production of ferrous or ferric chloride, at will from scrap iron and chlorine, such as successfully employed at the Oklahoma City softening plant and elsewhere, should not be overlooked as one method of producing an iron coagulant. Such had proved the least costly procedure at points remote from sources of copperas or ferric salt supply.

1. *Arthur Clark (The Barrett Co.), New York;* 2. *Chas. H. Becker (R. D. Wood Co.), Philadelphia, Pa.;* 3. *E. A. Johnson (Pittsburgh Meter Co.), Pittsburgh, Pa.;* 4. *Ed. Thwaits, Engr. (Youngstown Tube Co.), Youngstown, Ohio; J. V. Kelly (Darco Corporation), New York;* 5. *M. C. Allan (Builders' Iron Foundry), Providence; Fred Stuart (Activated Alum Corporation), Baltimore, Md.*

At N. E. W. W. A.'s Barn Dance

1. *Ralph Butts and Mr. and Mrs. Charles H. White of Asbury Park, N. J.;* 2. *Mr. and Mrs. J. Herman Smith of Boston;* 3. *The Assistant Secy., Marcella Sachs, and the Secretary, Frank Gifford of Boston, Miss (?) "Vickie" Arnold of New York City (We Regret That These Three Pictures Were Not Available When the October Issue Containing Others, Went to Press. For Them We Are Indebted to Mr. Fox of Johns-Manville, as "Principal Assistant Snapshooter" to Harry Faber.—Ed.)*

Ferrisul," constituting a by-product from Merrimac Chemical Co., was made from pyrites cinder and sulphuric acid. The first production had cost about $500 per ton as compared to the present price of $30.00 per ton. Especially attractive had it been in industrial water treatment to secure maximum silica removal.

Chemists' Round Table*

(STUART E. COBURN, *Leader*)

For the group, whose primary interest is in water purification problems, a separate session on the closing day was devoted to the Chemists' Round Table discussion.

"What Constitutes a Safe and Satisfactory Drinking Water"?

This title was the general topic of the entire session and Mr. Coburn led discussion which followed the subsequent, more detailed, papers. In addition to the title

*Reported by H. A. Faber, Research Chemist, The Chlorine Institute, and Associate Editor, WATER WORKS AND SEWERAGE.

E. W. Campbell, Chief Engr., State Dept. of Health, Augusta, Me.

F. H. Kingsbury, Sr., Asst. Engr., Mass. Dept. of Health, Boston. C. P. Moat, Chief Chemist, Vermont Dept. of Health, Burlington

given, Mr. Coburn stressed the variety of means employed to determine the quality of a given water.

The sanitary survey, which constitutes the first step in the examination of a new water supply, is a means of condemning an old supply or determining additional purification which may be necessary, or locating dangerous cross-connections. As an aid to such a survey, chemical analyses define the desired quality and give warning of probable consumer complaints. Similarly, bacterial analyses aid the survey and are essential to determine water quality as it exists at the time of sampling. In conjunction with these measurements, microscopic analyses may so early reveal the presence of taste and odor-producing organisms as to permit corrective or preventive treatment.

"Sanitary Survey of Sources" by CHARLES L. POOL, Sanitary Engineer and Chemist, State Department of Health, Providence, R. I.

The six lines of defense (in water purification) enumerated by the late Alan Hazen were cited as applicable to a sanitary survey. Mr. Pool elaborated upon the protection of watersheds, upon the advantages and limitations of time storage as a natural method of purification, and upon the filtration process which should be applied to all surface waters. The advantages of chlorination, to assure final quality of water, were held to be a final safeguard for all processes which may precede this step.

Even with proper preliminary treatment, the distribution system presents a further hazard. Cross connections, back-siphonage, pollution of open holding tanks, or equalizing reservoirs may each or all complicate the delivery of a safe water. Analytical methods serve as a check on the efficient maintenance of all the earlier methods of protection. Further, to these precautions he added the advantages of stimulation and authority supplied by the supervision of health department officials.

"Chemical Analyses," by CHARLES D. HOWARD, Director, Division of Chemistry and Sanitation, State Laboratory of Hygiene, Concord, N. H.

As an indicator of water quality, chemical analyses do indicate certain standards and the efficiency of purification, but they must be held secondary to bacteriological results. It must be recognized that our chemical tests are a series of experiments to determine only certain selected characteristics rather than a complete analysis as would be reported for most materials.

The interpretation of these tests is dependent upon local conditions (in the case of hardness) and upon the type of water (to determine coagulation efficiency) so that no fixed standards are possible. By using a variety of chemical analyses as illustration, Mr. Howard presented examples of interpretation of the meaning of several constituents. In summary, he noted that such analytical data alone are of great assistance but presented no certain evidence in determining the presence or absence of pollution.

"Bacterial Analyses," by E. W. CAMPBELL, D. P. H., Director, Div. of Sanitary Engineering, Department of Health, Augusta, Maine.

The procedure employed by the Maine Department of Health Laboratory was described in some detail. Monthly bacteriological and semi-annual sanitary chemical analyses are made of each surface supply in the state. Ground water supplies are examined each three months. Of the municipal supplies in the state only three have their own laboratories. Yearly chemical and bacteriological analyses are performed on the group of commercial spas found in the state. The numerous semi-public supplies—camps and tourist homes—are inspected and supervised by the department.

Of the 163 public supplies in the state of Maine only 29.4 per cent meet Treasury Department standards, but this per cent serves 96 per cent of the population. Only the small supplies contributed to the poor record and today serious pollution is limited to but 2 per cent of these.

"Microscopic Analyses," by MARSHALL S. WELLINGTON, Sanitary Engineer, New Haven Water Company, New Haven, Conn.

Following very objectionable taste and odor conditions, prevailing in the New Haven supply during 1928 and 1929, the use of microscopical methods to predict growth of the responsible organisms became imperative. The supply is obtained from eleven reservoirs, and the plan inaugurated was to maintain a constant plankton check on a weekly sample from the intake of each reservoir. This has been done since 1930 and only five instances of taste or odor complaint have been reported since.

As the examination of nearly 600 samples each year involves considerable detail, the seven types of organisms known to have caused trouble constitute the routine examination and only when large numbers of other organisms are present are they noted. When samples from a reservoir show either a sudden increase or a regular continued increase in numbers of these organisms, copper sulphate treatment is begun and continued as long as may be necessary. Suspending a bag of the material from a bridge into the stream feeding the reservoir has proven successful means of dosing.

Mr. Wellington also described the correction of a serious condition arising from bacterial aftergrowths in mains. Although sterile water was delivered into the

David A. Heffernan, Supt., Milton, Mass. (Too Many Pipes in His Streets); Samuel J. Kyle, Supt., Ansonia, Conn. (Theodore Bristol's Superintendent and Friend); Ernest A. Merrithew, Supt., Saugus, Mass. (Used a Can Opener on State-Federal Highway Treasury)

distribution system, organisms of the coli-aerogenes group were found in 0.1 cc. samples taken from taps, and 15 per cent of these showed complete coli confirmation. Cross-connections were believed not to be responsible and the mains were only 5 years old. By employing chlorine-ammonia treatment to carry a residual of 0.11 p.p.m. through the system, the condition had been entirely corrected. Where chlorination had produced no residual at a point in the system seven miles distant, following the addition of ammonia a residual was found at the same point within 24 hours.

Discussion following the presentation of the papers was devoted largely to the still-significant problem of cross-connections. A local health ordinance requiring the issuance of a permit prior to drilling any new well was cited as one means of checking on new cross-connections. It was suggested that examinations of industrial connections should be frequently repeated to prevent new and unrecorded situations. Multiple opportunities for such connections occur at sewage treatment plants, those for priming pumps and bearing seals, and even temporary hose connections, being cited as instances.

Superintendents' Round Table

(WARREN J. SCOTT, PRESIDING)
(HAROLD L. BRIGHAM, LEADER)

"Should Fire Hydrants Be Painted to Indicate Capacities," by JOSEPH W. RANDLETT, Supt., and Treasurer, Water Department, Richmond, Me.

In introducing Mr. Randlett, the chairman pointed out that the speaker was also Fire Chief and at the time was serving as President of the Fire Chief's Association of New England. Particularly well qualified was Mr. Randlett, then, to discuss the topic of hydrant capacity evaluations and the value of using distinguishing color schemes and hydrant markings.

Intended to develop discussion and reports of merit or shortcomings, of a standardized and uniform scheme of painting fire hydrants in distinguishing colors to indicate the available fire stream flow and pressures from each hydrant on the system, Mr. Randlett reviewed the developments in this matter from the beginning and endorsement of the scheme by the Maine Water Utilities Association some years ago, then more recently (1934) by the New England Association, and now (1937) by the American Water Works Association. (The color scheme of standard chrome yellow barrel, with green, yellow, or red tops to signify high to low capacities has been frequently referred to in various issues of WATER WORKS AND SEWERAGE. Readers who desire a copy of the approved scheme of painting and markings can find such in the journals of the three associations mentioned. Or, they may secure copies of the approved committee recommendations by applying to the headquarters office of either of the three associations. —Ed.)

New Director, Theo. L. Bristol, President, Ansonia Water Company, Ansonia, Conn.

Past President Roger W. Esty, Supt., Danvers, Mass.

1. Geo. H. Gleeson (Worthington-Gamon Meter Co.), Harrison, N. J.; 2. T. L. Cate, Supt., Laconia, N. H.; 3. Herb B. Crowell (Rensselaer Valve Co.), Troy, New York; 4. E. T. McDowall, Supt., Biddeford, Me.; 5. "Scotty" (Don't Have to Look Twice) Wm. Marshall, Supt., Georgetown, Mass.; 6. Wm. Luby, Water Supt. and Director of Works, Troy, New York; 7. F. S. Brainerd (Meter-Master Co.), Hartford, Conn.

Daniel M. Sullivan, Comm. Public Works, Boston; Jos. W. Randlett, Supt. and Fire Chief, Richmond, Me.; Patrick J. Kelly, General Foreman Water Dept., Boston

Mr. Randlett told of the acceptance and appreciation of the scheme by associations of Fire Chiefs; the opinion of many that the scheme was to prove only second in importance to the standardization of fire hose connections. Especially noteworthy had been the enthusiastic report of the Newark, N. J., Fire Department following the adoption of standard markings in that metropolis. The only objections to the scheme had come from interests not wishing to disclose, for general view, the value of the mains and the sub-normal property protection afforded by deficiencies in main capacities or pressures. Editors of papers had found the topic of hydrant markings to possess news value and, therefore, space worthy.

In reply to questions, and from the discussion ensuing, it was stated that red-top (lowest capacity) hydrants had to date not affected insurance underwriters' evaluations or rates. Neither had there been any appreciable

Wm. C. Hawley, Supt. and Vice Pres., Penna. Water Co., Wilkensburg, Pa.

A. Clinton Inglee Pres.-Elect, Water Works Mfgrs. Assn., New York

demand on the part of property owners for service by larger mains or hydrants of higher capacities. The scheme of marking, replied Mr. Randlett, did not include any special designation of those hydrants on the ends of main extensions—i.e. dead ended hydrants.

Concerning flow tests, the underwriters accepted such tests made at key locations, rather than on every individual hydrant. Mr. Randlett pointed out the importance of uniformity in procedure when making the evaluating flow tests, and considered that there was need for greater standardization of practices therein.

"Should Relocation of Mains Necessitated by State and Federal Highway Projects Be Paid for by the State"? was the question discussed by ERNEST A. MERRITHEW, Supt. of Public Works, Saugus, Mass., who presented the experiences of Saugus, confronted with an estimated cost of $20,000 to relocate and lower 5,450 feet of mains, services, hydrants on a State-Federal project involving regrading and widening of U. S. Route No. 1 through his town. The problem was—Where to get the money at the time.

Mr. Merrithew lost no time in placing his predicament before the State Highway Commission and Federal authorities. After considerable argument and hurried conferences the authorities agreed that the cost of main relocations could legally be considered a parcel in the general contract. Under supervision of the speaker the changes were made and the costs (*believe it or not*) came out of the Highway Department's funds. (Applause!)

Having secured the $20,000 saving to the town, Mr. Merrithew set about to secure additional improvements looking to the future, the result being a bond issue of $40,000 which permitted needed main extensions, or duplicate mains (12,462 ft.) and new fire hydrants, gated on 6 inch stubs on the original lines and the new. In the relocation work the highway authorities agreed to replacement of old mains with new pipes, whereas the new type Eddy hydrants were paid for by the town. Mr. Merrithew felt that the town had gotten very fair treatment on this project and had benefited materially in the betterments at a minimum of expense to the community.

ROGER W. ESTY (Danvers, Mass.) said that the value of making contacts and friends in the Association had been demonstrated factually when the Superintendent of Saugus had quickly informed his neighbor Superintendent of Danvers of the developments. Faced with highway relocation and widening, he had gone promptly to the authorities and arrangements had been completed on the same basis as at Saugus. He had been advised that the Highway Department's policy in the future would be to assist municipalities on all major highway projects. What might be the policy in respect to secondary or local, as compared to national, highways had not been determined.

FRANK GIFFORD, Sec'y., of N.E.W.W.A., pointed out the marked difference in the Saugus and Danvers experiences and those faced by him in years past, as Manager of the Dedham Water Company. He cited some demands for main replacements and service line installations made upon the water utility which seemed in excess of anything reasonable. There was no debating the matter in those days and possibly even now a privately owned company would get sparse consideration. And, WM. C. HAWLEY (Wilkinsburg, Pa.) lamented with Mr. Gifford that his company had recently paid out almost $30,000 to meet Penna. Highway Department demands for relocation.

"Collecting Water Bills," constituted an insight into methods employed in a small municipality. CHAS. W. EASTER, long time Superintendent of Water at Claremont, N. H., told the story.

The successful scheme in Claremont involved monthly billings and two postal card warnings, when meter readers report high readings. The minimum charge is required to be paid 6 months in advance, everybody being treated alike. That was an important consideration, said Mr. Easter. For services installed, advance payment was universally required. Shut off notices are mailed at mid-month but weekly installment payments had been accepted rather than practice the shut off. By allowing "work-off" of the bill by those unable to find ready cash, the Water Department had often discovered good workmen for the regular force, or for intermittent jobs. Calls on delinquents by foremen had proved more fruitful in getting promises than money. Eventually letters written in long hand by Mr. Easter, and in varied language would be sent, usually bringing in the consumer to talk it over and pay something if not all. As the last resort; a telephone call, a few hours' grace, the cut-off.

Mr. Easter said that it was seldom necessary to shut off water twice and he warned superintendents that of the highest importance to any water utility was the policy of seeing that every promise made by the utility was kept promptly and to *demand* reciprocation of the consumer in the matter of keeping promises to pay. The use of firmness (as distinct from harshness) was his motto along with something of the human and personal, which might not be applicable in the larger communities. (The success of the Easter method can be gaged by the phenomenal fact that on January 15, 1937, uncollected bills amounted to the large sum of $7.00—by August, 1937, that had been cleared from the books of the Claremont Water Department having 1,917 services (pop. 13,000) and annual billings of $38,000.—Ed.)

A question: "Mr. Easter, have you ever tried turning accounts over to a lawyer for collection?" Mr. E.: "It wasn't worth a tinker's damn!"

(To us, Claremont's attainment has the ear-marks of a record. If any reader can point to one approaching or bettering it, tell us about it—we will want to tell others about it.—Ed.)

"Rate Structures," by THEODORE L. BRISTOL, President, Ansonia Water Company, Ansonia, Conn.

Mr. Bristol recounted developments in water rate making and pointed back to some of the ludicrous schemes and bases of rate making in his 40 years of experience in water utility operation. He reviewed the 1905 report of the N.E.W.W.A. Committee on Meter Rates (Jour. N.E.W.W.A., Vol. 19, No. 3) and the second and basically sounder recommendations of the

committee in 1914 (Jour. N.E.W.W.A., Vol. 28, No. 3) when the service charge was first suggested, as well as the sliding scale for meter rates. Then came the final and adopted report of 1916 (Jour. N.E.W.W.A., Vol. 30, No. 4) after much lengthy and heated discussion. There have been no changes made subsequently and the 1916 report still stands as the official recommendation of the association.

Mr. Bristol then analyzed the basic requirements in sound rate-making and referred to the outstanding paper in the Journal of A.W.W.A. for 1911—"Reasonable Return for Fire Hydrant Service"—by Metcalf, Kinchling and Hawley, which revealed the marked differences in per cent of gross revenue which should be derived for fire protection in small vs. large municipalities—(5,000 pop., 77 per cent; 50,000 pop., 32 per cent; 300,000, 13 per cent). In Wisconsin, for large cities, the Utility Commission sets $1.25 per capita as the fair value for fire protection, to be paid the water utility from general taxes.

For metered service, Mr. Bristol pointed out the distaste of the general public for the monthly "service charge." Instead, the same end would be attained by the "minimum charge" rule which seemed less objectionable to the consumer and more readily understood. However, in Connecticut the Commission requirement was that the charge be shown as a "service charge." The Ansonia Co.'s scale starts with ½ and ⅝ in. meters at $1.50 per quarter; 1 in. $5.40; 2 in. $18.00; 4 in. $63.00; 6 in. $118. Meter rates (quarterly billings) are:

First 2,000 cu. ft.—20 cts. per 100 cu. ft.
Next 23,000 cu. ft.—15 cts. per 100 cu. ft.
Next 75,000 cu. ft.—13 cts. per 100 cu. ft.
Next 150,000 cu. ft.—12 cts. per 100 cut. ft.
Next 750,000 cut. ft.—11 cts. per 100 cu. ft.
Over 1,000,000 cu. ft.—6 cts. per 100 cu. ft.
Over 2,000,000 cu. ft.—4 cts. per 100 cu. ft.
Over 4,000,000 cu. ft.—2 cts. per 100 cu. ft.

Hydrant rental is $10.00 per hydrant. In addition the inch-foot charge is allowed on mains above 4 in., at the rate of 92/100ths of a cent per inch-foot of main. Mr. Bristol pointed out that this year a change in industrial rates had been allowed the company to prevent development of a private industrial supply. The new rates (above) had the 2 cents and 4 cents rate added in consequence. He closed by pointing to the most recent rulings that existing replacement costs rather than original investment is the proper basis of rate making. He pointed out that inflation meant increasing rates and with it wages were being forced up to add operating costs. Therefore, increasing water rates seemed inevitable. Notwithstanding, water would always remain man's greatest asset at the least commodity cost.

ROGER ESTY rose in defense of the basic soundness of the "service charge"—now $1.20 per quarter in Danvers, Mass., where retirement of bonds would make it mandatory to reduce the rates generally. If a "minimum charge" existed that would have to be reduced also.

MR. CALDERWOOD (Nashua, N. H.) however, agreed with Mr. Bristol that the customer preferred to pay more for water used than pay the so-called ready-to-serve charge, regardless of explanations.

HARRY U. FULLER (Portland, Me., Water District) said that in Portland the scheme of covering up the service charge by showing details on the rear of the bill only, had been helpful in improving public relations. Someone questioned the legality of the practice which private companies could hardly get away with.

WM. C. HAWLEY (Penna. Water Co.) supported the "service charge" as basically correct, and "minimum charge" basically wrong. The public, he said, should become amenable in time to the more correct method. And, MR. MOULTON pointed out that the service charge was primarily a measure of supplementing the fire service charge taken from tax funds and constituted a form of sales tax.

"The Question of Dual Mains," by DANIEL M. SULLIVAN, Deputy Commissioner Public Works and Water Engineer, Boston, Mass.

Mr. Sullivan pointed out that the question of a main down each side of ordinary streets was open to much pro-and-con argument. For the past 30 years Boston had been placing mains on each side of streets, of 80 ft. width or greater, with advantages beyond that of no pavement cutting and shorter service lines. Under sidewalks, maintenance proved simpler and less costly, and there was less main damage there from traffic impact and electrolysis. In some instances space under one sidewalk would be taken up by other utilities, then the old main was left under the street and the new placed under the other available sidewalk. It was difficult to discuss comparative costs because the problems were usually of individual nature, and convenience, reliability and dependability of service were of more import than the relative cost.

D. A. HEFFERNAN (Milton, Mass.) saw the need of regulating utility usage of streets and sidewalks. In Milton sewers had right of way in the streets and other utilities left little space for the water mains under sidewalks. In reply, Mr. Sullivan said that in Boston location reservations for water mains were asked for in advance, usually ⅓ width of street from property lines. Sewers were always given the center of the streets in Boston.

LELAND CARLTON (Springfield, Mass.) told how the "Public Associates of Springfield" had been formed from utility representatives in 1914 who held weekly meetings to iron out locations. Generally the water mains had been allotted the E. or N. sides of streets 7 ft. out from curb lines; sewers always had the center; gas, electric, telephone, etc., elsewhere.

W. W. BRUSH (New York City) commented on the maze of underground structures in New York City, including steam lines, where Water Department had right of way over all substructures except subways and sewers.

"Water Works Funds for Water Works Purposes" was the topic opened for discussion by LELAND G. CARLTON, Registrar, Water Department, Springfield, Mass., who reviewed some of the legal decisions ruling against diversion of water works income to other municipal uses. In Springfield the law was clear and no funds could be transferred. Instead rates had to be cut to preclude surplus above that requisite for betterments. Recent legislation in Massachusetts and elsewhere indicated a trend to insure the water utility against diversion of water works income.

[Mr. Carlton will contribute an article on this topic for publication in this magazine. Due to the lateness of the hour his remarks were hurried and brief.—Ed.]

ROGER ESTY (chairman of Water Finance Law Committee) pointed out that the Massachusetts Legislature had a committee now studying the taxing situation and it was understood that it was in sympathy with the idea of private utility type of management and financing by all publicly owned utilities. The Water Finance Committee was keeping in active touch with the key men in the legislature and the helpful Mr. Weston, Chief Engr. of the Dept. of Health.

COAGULATION

Part IV. Effect of the Concentration of Alkaline Carbonates and Neutral Salts

By JOHN R. BAYLIS*
Associate Editor

PREVIOUS contributions to the series of articles on coagulation have been limited largely to the effect of adding silicates to water to aid coagulation. This in the reverse order in which most of the experiments were conducted, for the early tests were on synthetic waters. These synthetic waters were prepared by adding known amounts of alkaline and neutral salts to distilled water. In some series of the experiments, the concentration of the alkaline carbonates and the pH were varied over the range of natural waters. As was stated in the first article of the series on coagulation, the search to find the cause of the difference in the coagulation produced with synthetic water and that produced with natural waters resulted in finding that silica has considerable influence upon coagulation. These data were presented first because of their importance. More experiments on the effect of silica on coagulation will be given in later articles.

Silica, or lack of silica in waters, is not responsible for all coagulation trouble. In natural waters where some silica always is present, much of the influence on coagulation is produced by other causes such as pH, variation in the concentration of alkaline and neutral salts, and the presence of certain colloidal substances in the water. Temperature also has some influence.

The method of conducting the experiments is described in the December, 1936, issue of WATER WORKS AND SEWERAGE, pages 469-470. Figure 1, in this same issue (page 472) gives curves to show how silica, in a certain form, when added to solutions prepared from distilled water and calcium carbonates, widens the pH range at which good coagulation is obtained with aluminum sulfate.

In view of the silica effect, we may wonder if experiments on synthetic waters are now of value. They are not of as much value as they were thought to be heretofore, though they may serve a useful purpose in showing what would take place in the coagulation of water should the water contain no substances other than the coagulant and an alkali. The silica in natural waters, both ground and surface, aids the coagulation, though not to the extent shown in Fig. 1. There may be other substances present other than silica which give aid, and substances which interfere with the coagulation. Sometimes the aid given by silica is nullified by the retarding effect of other substances.

The purpose of presenting experiments on water in which no silica was present is to show the type of coagulation produced without influencing substances in the water. If, in the treatment of water, better coagulation is obtained than on synthetic water, then it is known that something is aiding the coagulation. Should equal results be obtained, and silica is present, very likely there is some retarding substance overbalancing the aiding effect of the silica. A knowledge of all of the influences effecting coagulation and how to properly evaluate their effect is essential in the study of coagulation.

*Physical Chemist, Dept. of Public Works, Chicago.

Effect of the Concentration of Alkaline Carbonates

Effect of Varying the Concentration of Calcium Carbonate

Solutions of calcium carbonate were prepared by bubbling carbon dioxide through a suspension of calcium carbonate in distilled water. The carbon dioxide was bubbled through until the amount of calcium carbonate in solution was between 200 and 300 p.p.m. This amount of calcium carbonate can exist in solution only in the presence of a large amount of carbon dioxide. The suspended calcium carbonate was removed by filtering through cotton and the solution stored in a stoppered bottle until used. Knowing the alkalinity of the strong solution of calcium carbonate, solutions of definite alkalinity were prepared by diluting with distilled water. In order to make the coagulation readily observable, a suspension of Fuller's earth was prepared and added to the water in amounts to give some definite turbidity to the water, usually about 30.

The pH of the solution was adjusted to that desired, the pH being lowered by bubbling carbon dioxide through the solution. Some increase in the pH could

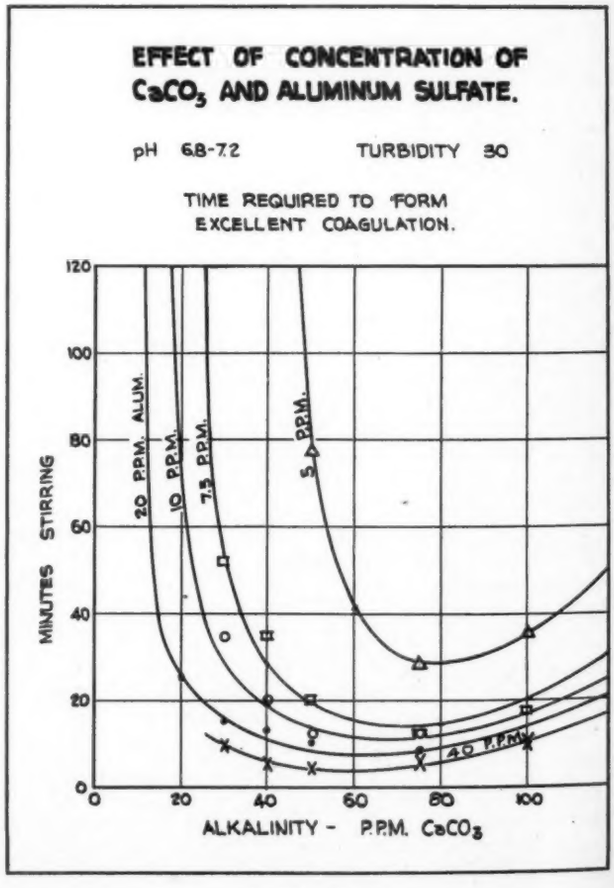


Fig. 7

TABLE 15. EFFECT OF CONCENTRATION OF $CaCO_3$ ON TIME REQUIRED TO FORM COAGULATION

Calcium carbonate added to distilled water.
Turbidity 30. Temperature 23° to 26° C. pH 6.8—7.2.
Average of Several Tests

Alkalinity	pH	Minutes Stirring Required to Form Coagulation. Just Visible	Small Particles	Fairly Good	Good	Excellent
		5.0 P.P.M. Aluminum Sulfate				
20	6.9	45	94			
30	6.9	33	71	113+		
40	6.9	21	30	60	96	
50	6.9	12	16	26	36	77+
75	7.0	6.8	9.4	12	17	28
100	7.0	7.1	10	13	18	35
		7.5 P.P.M. Aluminum Sulfate				
20	6.9	38	77	90+		
30	7.0	20	24	29	38	52
40	7.0	15	17	20	25	35
50	6.9	7.0	10	12	16	20
75	7.0	6.0	7.0	9.0	11	12
100	6.9	6.0	7.0	9.0	10	17
354	7.0	12	20	120+		
		10.0 P.P.M. Aluminum Sulfate				
20	6.9	40	60	100	120+	
30	7.0	16	23	26	30	35
40	6.9	11	13	15	17	20
50	6.9	5.7	6.8	8.0	9.7	12
75	6.9	5.8	6.9	8.1	9.6	12
310	7.0	7.0	9.0	13		
		20.0 P.P.M. Aluminum Sulfate				
20	6.9	13	16	18	22	25
30	7.0	5.5	7.0	8.5	12	15
40	7.0	6.0	8.0	9.0	11	13
50	6.9	4.5	5.0	6.0	7.0	8.0
75	6.9	3.5	4.4	5.3	6.9	9.1
100	7.0	3.5	4.5	5.9	7.9	10
310	6.8	4.0	7.0	9.0	120+	
		40.0 P.P.M. Aluminum Sulfate				
30	6.8	6.0	8.0	8.5	9.0	10
40	6.8	3.0	3.5	4.0	4.5	5.0
50	6.9	2.3	2.5	2.9	3.3	4.0
75	6.9	2.2	2.6	3.1	3.7	5.8
100	7.0	3.0	3.7	4.3	5.0	10
310	6.9	4.0	5.0	9.0	120+	
		60.0 P.P.M. Aluminum Sulfate				
50	6.8	1.7	2.0	2.5	3.0	3.5
75	7.0	1.3	1.7	2.0	2.5	3.3
310	7.0	4.0	7.0			

be obtained by pouring the water back and forth in beakers to drive off the CO_2 present. The distilled water contained some CO_2, and the addition of the calcium carbonate solution increased the amount somewhat. A pH of about 7.5 was the highest which could be produced in this manner before adding the coagulant, and the coagulant reduced this somewhat. When it was desired to have a pH higher than could be obtained in this manner, limewater was added. In such instances a lesser amount of the calcium carbonate solution was used so that the prepared sample would have an alkalinity approximately that desired. No great difficulty was experienced in producing a pH and concentration of alkali close to the desired amount.

A constant amount of aluminum sulfate was used in one series of experiments where the alkali concentration was varied. Enough of the coagulant was used to produce coagulation over a wide range of concentration. The data will show there is some effect of concentration upon the minimum amount of coagulant required to produce coagulation. Probably much of the difference in the time required to form coagulation as given in the tests can be attributed to the amount of aluminum sulfate used being close to the minimum amount required for some concentrations, and an excess over the minimum for other concentrations. If the amount of aluminum sulfate used had been varied with the alkalinity, so that just enough was used for each alkalinity to properly coagulate the water, the time of stirring required would have been nearer the same.

The effect of varying the amount of calcium carbonate and aluminum sulfate is given in Table 15. Figure 7 shows curves for the time of stirring required to form an excellent coagulation. In these tests the pH after treatment was kept as near 7.0 as possible, because this is close to the pH at which most rapid formation of the coagulation takes place. The results show that the time required to form good coagulation decreases as the calcium carbonate is increased up to about 60 to 75 p.p.m. Beyond this amount the time required to produce coagulation increases slightly and becomes considerably longer when the concentration of calcium carbonate is high. No explanation can be offered as to why the time of stirring has to be increased with high concentration of calcium carbonate, though it seems reasonable to expect that a longer time will be required when the concentration is low.

Figure 8 shows another form in which the data given in Table 15 may be plotted. Alkalinities higher than 50 are not shown because the lines would coincide so closely with the alkalinity of 50, except for very high alkalinities.

Effect of pH

The alkalinity and amount of aluminum sulfate were kept constant in certain tests, and the pH was varied. Table 16 gives the results of tests conducted at alkalinities of 20 to 75. The curves in Fig. 9 are for the time of stirring required to produce excellent coagulation. The hydrogen ion concentration of the water has great influence on the time required to coagulate synthetic waters, which is in accordance with the findings of others. Such a marked effect, however, is not found with natural waters within the range of pH of 5.6 to 7.4. The absence of silica is believed to be largely if not wholly responsible for the very narrow pH range in which there is rapid formation of the coagulation with synthetic waters.

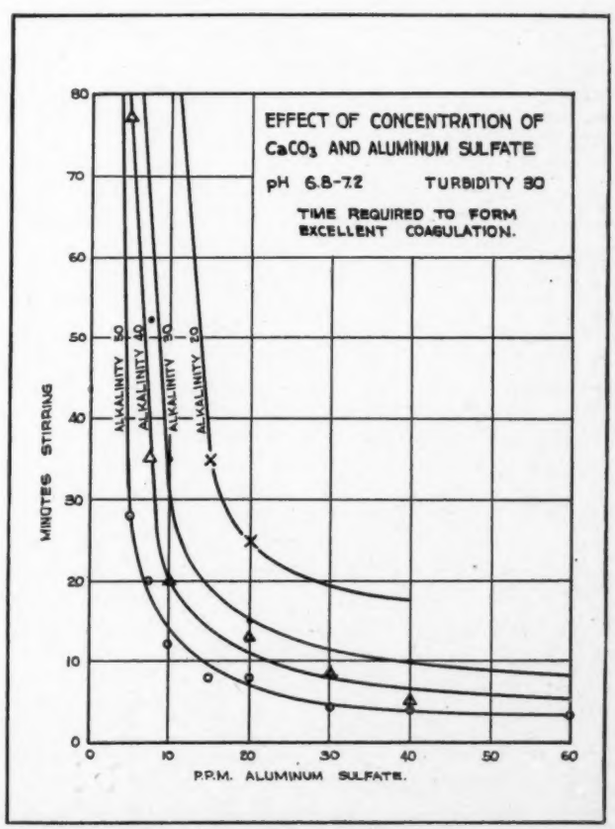


Fig. 8

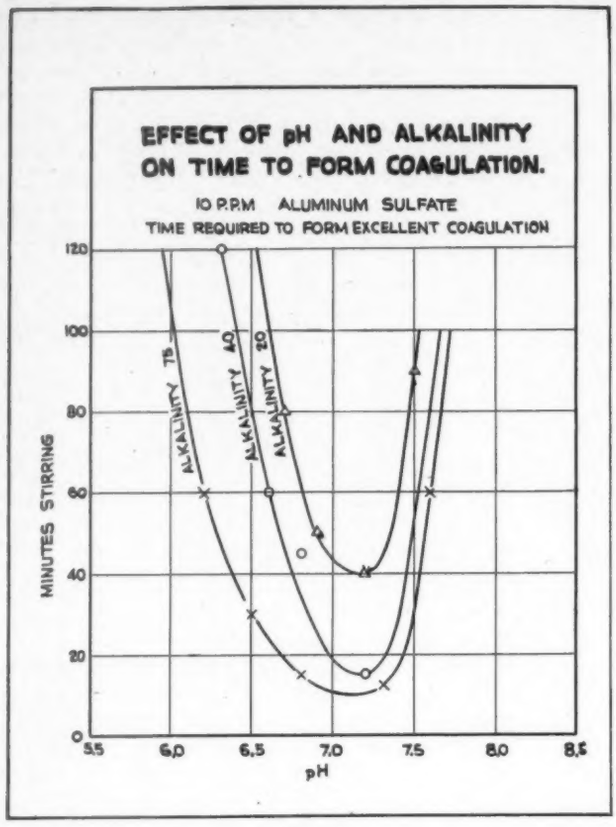


Fig. 9

In considering these data, we should bear in mind that the experiments are on synthetic waters and that the coagulation of natural waters may show results somewhat different, even at the most optimum pH, as was the case for the tests shown in Figs. 7 and 8. The data for pH values between 6.0 and 6.5 show such wide variation from coagulation of natural waters that there would be little similarity between results obtained on natural and synthetic waters at these pH values.

Effect of Varying the Concentration of Magnesium Carbonate

Magnesium carbonate solutions were prepared by adding the carbonates to distilled water and bubbling carbon dioxide through the solution the same as was done for calcium carbonate. Being more soluble than calcium carbonate, there was no difficulty in preparing solutions having an alkalinity of 400 to 500. Solutions for coagulation tests then were prepared by diluting portions of the strong magnesium carbonate solution with distilled water to some definite alkalinity. Fuller's earth was added to produce turbidity close to 30. The pH was adjusted to the desired figure by adding carbon dioxide or aerating the distilled water before it was used. The strong solution of magnesium carbonate had a much higher pH than that of the calcium carbonate, and when the distilled water was nearly free of carbon dioxide there was no difficulty in obtaining pH values for the treated samples of 7.0, or slightly higher, if desired. Some tests were run by adding a little lime or sodium hydroxide to produce high pH values.

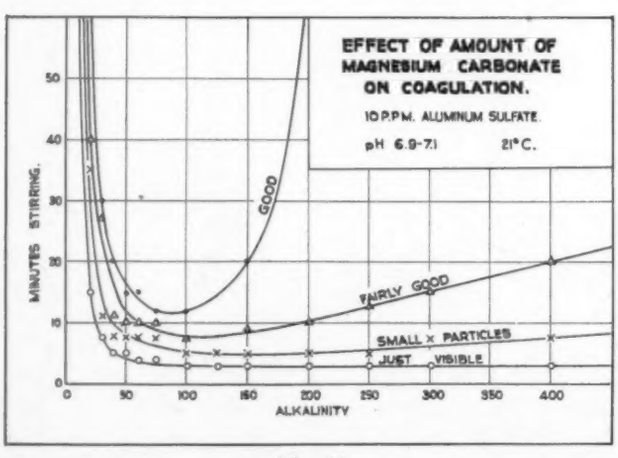


Fig. 10

Figure 10 shows the results of typical experiments on time required to produce coagulation with aluminum sulfate in water containing magnesium carbonate. In this series of tests, 10 p.p.m. of aluminum sulfate did not produce coagulation which was classified as excellent, but it produced good coagulation within a certain range of concentration. The amount of coagulant used, however, was enough to coagulate the water to the extent that it filtered to 0.0 turbidity. The effect of concentration upon the time required to form coagulation is approximately the same as that found for calcium carbonate. The shortest period of stirring to produce good coagulation is when the alkalinity is between 75 and 100. Lesser or greater concentrations require a longer period of stirring to give good coagulation. When the alkalinity was less than 25 or more than 200, good coagulation was not obtained with 10 p.p.m. of aluminum sulfate.

Effect of Varying the Concentration of Sodium Bicarbonate

A strong solution of sodium bicarbonate was prepared and diluted with distilled water to definite alkalinities. Fuller's earth was added to produce a turbidity close to 30. The pH of the solution was varied either

TABLE 16. EFFECT OF pH ON TIME REQUIRED TO FORM COAGULATION

Calcium carbonate added to distilled water. Turbidity 30 23° to 26° C. 10 P.P.M. Aluminum Sulfate

Alkalinity	pH	Just Visible	Small Particles	Fairly Good	Good	Excellent
20	6.0	105				
20	6.4	70	90	120		
20	6.7	25	40	50	60	80
25	6.9	15	25	30	40	50
27	7.2	7.5	12.5	15	20	40
30	7.5	12.5	25	30	50	70
33	8.0	30	50	70		
40	5.8	120				
40	6.3	60	75	90	105	120
40	6.6	30	35	40	45	60
40	6.8	20	23	27	30	45
40	7.2	5	7.5	10	12	15
75	5.8	(No coagulation within 2 hours.)				
75	6.2	20	25	30	45	60
75	6.5	10	12	15	20	30
75	6.8	8	9	10	12	15
75	7.3	5	6	8	10	12
75	7.6	7.5	10	15	20	60

TABLE 17. EFFECT OF VARYING THE AMOUNT OF SODIUM BICARBONATE ON TIME REQUIRED TO FORM COAGULATION

10 P.P.M. Aluminum Sulfate. Turbidity 30. 24° C.

Alkalinity (Expressed as P.P.M. of $CaCO_3$)	pH	Minutes Stirring Required to Form Coagulation. Just Visible	Small Particles	Fairly Good	Good	Excellent
20	7.0	50	120			
30	6.9	20	25	30	40	50
50	7.0	8	10	12.5	15	20
100	7.0	5	7.5	9	11	12.5
500	7.0	7.5	10	(No change after 10 min.)		
1000	7.1	12.5	120			

TABLE 18. EFFECT OF CALCIUM SULFATE ON TIME REQUIRED TO FORM COAGULATION

Calcium carbonate added to distilled water.
Calcium sulfate produced by neutralizing some of the calcium carbonate with sulfuric acid. The alkalinity given is after adding the acid. 24° to 26° C.
Fuller's Earth added to produce turbidity of 30.

Minutes Stirring Required to Form Coagulation.

Alkalinity	P.P.M. $CaSO_4$	pH	Just Visible	Small Particles	Fairly Good	Good	Excellent
			10 P.P.M. Aluminum Sulfate				
25	0	6.9	25	30	45	52	60
25	68	6.9	5	6.5	8	9.5	11
75	0	6.9	5	6.5	8	9.5	11
26	0	6.9	25	30	45	52	60
26	68	6.9	5	6.3	8.7	10	15
75	0	6.8	4	5	6	7	8
23	70	6.9	7	9	11	13	15
75	0	6.8	7	8	9	11	13
			7.5 P.P.M. Aluminum Sulfate				
29	100	5.3	45	120			
33	100	5.7	15	20	30	50	
31	100	6.0	7.5	10	15	20	
33	100	6.8	6	8	10	15	20
27	100	7.0	6	7.5	9	10	13

TABLE 19. EFFECT OF VARIOUS SULFATE SALTS ON THE TIME REQUIRED TO FORM COAGULATION

Calcium carbonate alkalinity of 20. Turbidity 30. 22° to 25° C.
10 P.P.M. Aluminum Sulfate

Minutes Stirring Required to Form Coagulation.

Compound	P.P.M. SO_4	pH	Just Visible	Small Particles	Fairly Good	Good	Excellent
	0	6.2	90				
Na_2SO_4	9	6.2	75	105	130	150	
$(NH_4)_2SO_4$	11	6.2	65	75	100	110	120
$MgSO_4$	10	6.2	(No coagulation within 2 hours.)				
Na_2SO_4	67	6.2	7.5	10	12.5	15	45
$(NH_4)_2SO_4$	70	6.2	7.5	10	12.5	15	45
$MgSO_4$	40	6.2	10	12.5	15	20	45

by adding CO_2, or by the addition of some sodium carbonate in place of the bicarbonate. Table 17 gives a typical series of tests on varying the amount of sodium bicarbonate. The tests give characteristics somewhat similar to the other alkaline carbonates, though the concentration for the minimum time of stirring when 10 p.p.m. of aluminum sulfate are used is higher than for calcium carbonate.

Rain Water

Rain water with calcium carbonate added to give some definite alkalinity was used in some of the coagulation experiments. Figure 11 gives the results of one series of tests in which the pH was varied. It is interesting to note that the time required to form the coagulation is short over a much wider pH range than is the case for water prepared by adding alkali to distilled water. Distilled rain water produced results the same as distilled Lake Michigan water. The rain water used in these experiments was collected from one of the downspouts of the Experimental Plant. The contact with the roof may have added to the constituents of the water slightly.

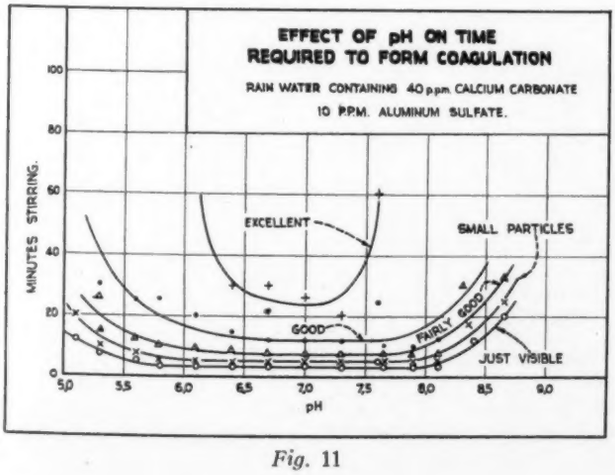


Fig. 11

The difference in the results produced with rain water compared with distilled water was puzzling at first, but after finding that silica influences the coagulation, this was thought to offer the explanation for the difference. A few tests to determine the amount of silica in rain water were made and show there was 0.5 to 1.0 p.p.m. of silica as determined by the molybdate test. As this test gives the soluble silica only, there probably was more silica in the water than the amount found by this test. One gravimetric test gave about 1.0 p.p.m. of silica in the particular sample tested, but gravimetric tests for such a small amount of silica are not exact unless about 10 or more liters of the water are evaporated to dryness, whereas only two liters were evaporated to dryness in the test given. The amount of silica in the rain water seems low to produce such marked effect upon coagulation, yet nothing else so far has been found to which any of the aid to coagulation may be attributed.

Lake Michigan Water

A large number of experiments to determine the time required to coagulate Lake Michigan water have been made. In some of these tests the pH was varied over a wide range. Figure 12 shows the results of a typical series of tests. There is coagulation within a short time between pH of 5.6 and 7.4. The Lake Michigan water has an alkalinity of 120, composed principally of calcium carbonate. The water contains about 35 p.p.m. of Ca, 10 p.p.m. of Mg, 12 p.p.m. of SO_4, and 5 p.p.m. of Cl.

Several samples of water from other sources have been used in some of the coagulation tests. Low alkalinity waters give results somewhat similar to the lake water or to rain water in which calcium carbonate is added.

Effect of Neutral Salts on Coagulation

Calcium Sulfate

Experiments were conducted to determine the effect of calcium sulfate on the coagulation of synthetic waters. In some tests the calcium sulfate was added to the water, and in others it was produced in the water by adding sulfuric acid to neutralize part of the alkali present. Table 18 shows the effect of adding sulfuric acid to water of high alkalinity to reduce the alkalinity to about 25 to 30. There is broadening of the pH range in which rapid formation of the coagulation is produced, but the range was not broadened to equal that of most natural waters. When the pH is maintained close to 7.0, the addition of calcium sulfate, or the production of calcium sulfate by the addition of sulfuric acid to the water, has an effect similar to increasing the amount of calcium carbonate in the water.

Two of the samples used in the tests given in Table 18 contained 68 p.p.m. of calcium sulfate and an alkalinity of about 25. These waters, at a pH of 6.9, coagulated in approximately the same time as was required to coagulate water of the same pH containing an alkalinity of 75. Water containing 25 p.p.m. of $CaCO_3$ and 68 p.p.m. of $CaSO_4$ has about the same amount of calcium in it as water with 75 p.p.m. of calcium carbonate. The time to coagulate was much shorter than that required for water with an alkalinity of 25 which contained no sulfates other than that included in the coagulant. In other tests in which approximately 200 p.p.m. of calcium sulfate were added to synthetic waters, the time

required to form the coagulation appeared to be about the same, or it was increased only slightly over the time required for 68 p.p.m. of calcium sulfate. If there is a slight increase in the time required to form coagulation, it probably is an effect similar to that produced by a high alkalinity. Adding calcium sulfate to natural waters produced almost no effect and it may be concluded that the concentration of calcium sulfate within reasonable limits has little effect upon the coagulation of water with aluminum sulfate.

Other Neutral Salts

A few experiments were run with sodium sulfate, magnesium sulfate, and ammonium sulfate. High concentration of these salts shorten the time required to form coagulation with water containing a calcium carbonate alkalinity of 20 and a pH of 6.2. The results of a series of tests are given in Table 19. The effect of sodium sulfate on water containing 75 p.p.m. of calcium carbonate is shown in Table 20. There is almost no effect up to 100 p.p.m. of calcium sulfate. These results indicate that there may be some widening of the pH range as a result of the addition of such compounds to synthetic water, though not much more than that produced by increasing the alkaline carbonate. Tests have not been made on natural waters, but it is likely that the presence of such salts in natural waters up to about 100 p.p.m. will have almost no effect upon the coagulation. Over 100 p.p.m., there may be some retarding effect.

The results of one series of experiments on the effect of sodium chloride are given in Table 21. With an alkalinity of 50 p.p.m. of calcium carbonate in distilled water, the addition of sodium chloride up to 1,000 p.p.m.

TABLE 20. EFFECT OF SODIUM SULFATE ON THE RATE OF FLOC FORMATION

10 P.P.M. Aluminum Sulfate. Turbidity 30. 22° C.

P.P.M. Na_2SO_4	pH	Minutes Stirring Required to Form Coagulation. Just Visible	Small Particles	Fairly Good	Good	Excellent
		75 P.P.M. Calcium Carbonate				
0	5.9	45	50	55	60	90
0	6.9	7	10	12	14	15
20	7.0	7	8	10	12	14
50	7.0	7	8	10	13	15
100	5.9	13	18	25	60	
100	7.0	7	9	11	14	15
500	6.9	7	9	11	14*	
1000	6.8	7	9	11	14*	
		25 P.P.M. Calcium Carbonate				
100	6.2	7.5	8.7	10	12.5	
100	6.9	8	10	11	12.5	20

*No change in the coagulation after 14 minutes.

TABLE 21. EFFECT OF SODIUM CHLORIDE ON THE RATE OF FLOC FORMATION

Calcium carbonate alkalinity of 50 added to the distilled water.
Alkalinity of Lake Michigan water 120.
Fuller's Earth added to both waters to produce turbidity of 30.
7.5 P.P.M. Aluminum Sulfate. 19° to 24° C.

P.P.M. NaCl	pH	Just Visible	Small Particles	Fairly Good	Good	Excellent
		Sodium Chloride in Distilled Water				
0	7.0	7.5	11	12.5	15	20
10	7.0	7.5	11	12.5	15	20
50	7.0	7.5	11	11.5	12.5	20
100	7.0	7.5	11	11.5	12.5	20
500	7.1	7.5	10	11	12.5	20
1000	7.0	7.5	10	11	12.5	20
		Sodium Chloride in Lake Michigan Water.				
0	7.1	5	7.5	10	12.5	15
10	6.8	5	7.5	10	12.5	15
50	6.8	5	7.5	10	12.5	15
100	7.0	5	7.5	10	12.5	15
500	7.0	5	7.5	10	12.5	15
1000	7.0	5	7.5	10	12.5	15

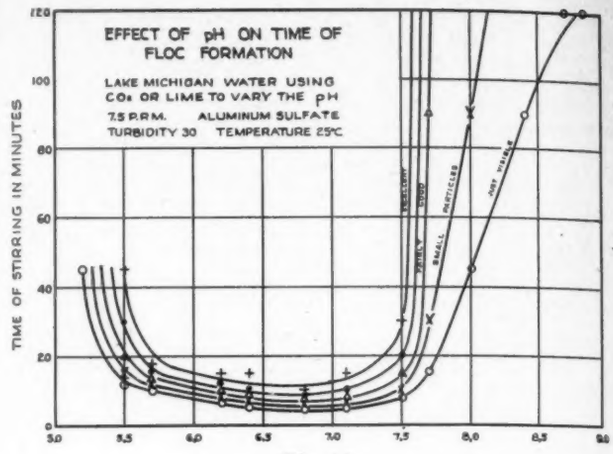


Fig. 12

produced almost no effect upon the time required to coagulate the water. Another series of experiments was run on the Lake Michigan water at a pH of about 7.0. These tests, which also are given in Table 21, indicate that the addition of sodium chloride up to 1,000 p.p.m. produced no effect upon the time required to coagulate the lake water.

From such experiments as have been made with neutral salts, the results indicate there is some widening of the pH range towards the acid side as a result of the addition of neutral salts, but that much of this effect may be attributed to the concentration of the positive ion. Widening of the pH to the acid side by the addition of neutral salts to water is in accordance with the findings of others. The experiments indicate that the concentration of neutral salts in natural waters, where the amount is not more than 100 p.p.m., has no effect upon the coagulation, and that very large amounts will have little or no effect upon the coagulation.

Summary

Increasing the concentration of calcium carbonate in water decreases the time required to coagulate the water with a given amount of aluminum sulfate, up to 60 to 75 p.p.m. of calcium carbonate. Beyond this amount, the time required increases gradually as the concentration is increased.

Increasing the concentration also broadens the pH range over which coagulation is obtained with a given amount of aluminum sulfate.

Increasing the concentration of magnesium carbonate or sodium bicarbonate produces the same effect upon coagulation as increasing the calcium carbonate.

Rain water with calcium carbonate added coagulates over a wider pH range than distilled water with calcium carbonate.

The pH range for rain water is close to that of most surface and ground waters.

A slight amount of silica in rain water is believed to be responsible for it coagulating over a wider pH range than distilled water.

The addition of the sulfates and chlorides of calcium, magnesium, and sodium to distilled water produce results somewhat similar to increasing the carbonates of these elements, though the sulfates widen the pH range of good coagulation more to the acid side than the carbonates.

The addition of these neutral salts to natural waters produces little or no effect upon the coagulation of such waters, with aluminum sulfate.

ACTION!
KEY-NOTE OF NEW JERSEY SECTION MEETING

Free Discussion of Proposed Water Supply Legislation Results in Important and Pointed Resolutions.

ON OCTOBER 15th and 16th, in Atlantic City, American Water Works Association's New Jersey (youngest) Section held an outstanding meeting, both from the standpoint of program and accomplishments. The official registration of 195, total, revealed the attendance of 89 members, 73 men guests, 33 ladies.

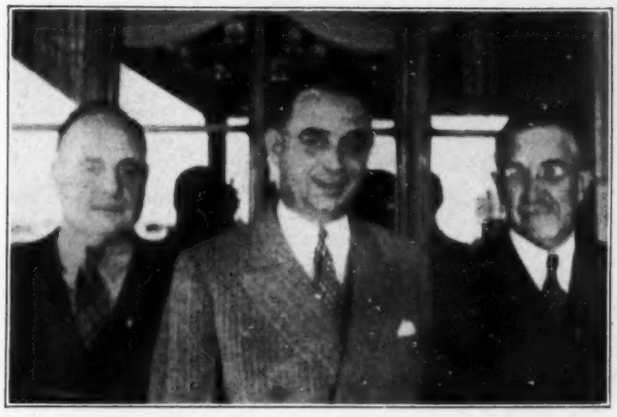
Outstanding was the paper presented by Charles H. Capen, Jr., which analyzed and revealed the problems involved in "Major Water Supply Developments in New Jersey." Mr. Capen's paper, having been pre-printed in the September number of the Journal of A.W.W.A., was presented by the author in digest form, preliminary to free and pointed discussion of a matter of high importance to future water supply developments in New Jersey. From many sides came deserved high praise of this paper by North Jersey Water Supply Commission's capable engineer, which served as a stimulus for free discussion and criticism directed at proposed legislative acts introduced by New Jersey's Water Policy Commission. Results: A positive stand being taken by the Section in the matter of securing relief from conflict of governmental authority and, thereby, hazard to effective and broad water supply planning in New Jersey.

Important Action Taken

Early after its formation the N. J. Section set up an active Committee on Additional Water Supply, which has acted as an investigating and advisory body on this important subject, to the Board of Trustees. In the Atlantic City meeting resolutions were passed, reiterating the proven need for action, without more delays, and condemning the legislation proposed last year by the present State Water Policy Commission. It was the belief that there should be but a single commission in charge of water supply developments; with power to consolidate, finance, construct and operate the supplies of the state, where the public interest indicates the need. In the discussion it was definitely suggested that the Section, out of interest in and for protection of the profession, should take prompt steps to have suitable legislation introduced. In the resolutions passed the matter was referred to the Board of Trustees and the Committee on Additional Water Supply, with power to act. The Resolutions:

Wm. J. Orchard
To Him Recognition and Honorary Membership.

Chas. H. Capen, Jr.
To Him, High Praise for His Paper.



The President and Section Chairmen

E. F. Dugger, President of A.W.W.A., Flanked by Retiring Chairman Samuel F. Newkirk, of Elizabeth (Left) and Incoming Chairman Wm. R. Conard of Burlington.

Resolution No. 1—Whereas the investigations of the Water Supply Committee of the New Jersey Section of the American Water Works Association and the opinion of competent technical authorities clearly indicate that the state of New Jersey may, in certain areas, expect a serious shortage in available potable water supply in the very near future. It is resolved by the members of the New Jersey Section of the American Water Works Association in meeting assembled in Atlantic City on October 16, 1937, that there should be prompt action to bring about extensions of the major water supply facilities of the state of New Jersey so that an imminent and disastrous shortage of water shall be averted.

Resolution No. 2—Be it further resolved that the legislation introduced this year in the state legislature looking toward an amicable arrangement between the North Jersey District Water Supply Commission and the Water Policy Commission is inadequate, that there should be a single commission appointed with power to finance, construct, control and operate consolidated water supply facilities and that this New Jersey Section of the American Water Works Association directs their water supply committee, subject to the approval of the Board of Trustees, to use their best efforts toward this end.

Resolution No. 3—Be it further resolved that this matter be referred to the Section's Board of Trustees and to its Committee on Additional Water Supply with power to act.

The Annual Dinner

At the well-attended Annual Dinner the principal speaker was the President of A.W.W.A.—E. F. Dugger—who presented to W. J. Orchard, Director of the Section, the certificate of Honorary Membership—the recognition voted Mr. Orchard at the close of the 1937 Convention in Buffalo for his outstanding services to A.W.W.A. In presenting the certificate, President Dugger reviewed the attributes of the recipient and expressed high personal appreciation for his guidance as a Director, and Member of the Executive Committee.

Then the new Chairman of the Section—W. R. Conard—made a presentation of the official badge of membership to retiring Chairman—Sam. F. Newkirk, Jr.—as the first chairman of the New Jersey Section, and in

recognition of his energizing services and work in organizing this youngest section of A.W.W.A.

In reporting progress made by the Section, Professor H. N. Lendall, the new Secretary, pointed out that the past year had witnessed a 60% gain in New Jersey membership—now boasting 177 members as compared with 54 at the start.

President Dugger then made essentially the same excellent address on the affairs and proposed activities of A.W.W.A., which he has earlier made before other Sections, and as recounted in previous issues of this magazine. He laid especial emphasis on the aims and plans of A.W.W.A. to better the social and financial status of water works operators and insure longer tenure of office; the need for a stronger A.W.W.A., with more State Sections and provision for a grade of membership which will allow underpaid operators to become affiliated with A.W.W.A. at a cost less than that of the full member grade. He spoke at some length on the value of making friends and building good will of the public, looking toward a betterment of status and defeating political manipulations of water departments. Mr. Dugger stressed the fact, that the A.B.C.'s of good public relations involved good-housekeeping, consideration of the consumer, courtesy to all—none of which cost much but had inestimable value. To the 400-member gain since

Divided the Deep Well Pumping Symposium Three Ways

A. W. Ross, Vice President Layne-N. Y. Co.; H. W. Stoddart, Worthington Pump and Mchy. Co..; Henry Folz, Byron-Jackson Company.

the first of the year, he pointed with satisfaction as an index of "What's Ahead for A.W.W.A."

At the close of the dinner some fun was had at the expense of a "class" of operators lined up at the head table and put through a laugh-getting quiz by the "Professor of Fizz"—Bill Flanders.

Technical Sessions

The technical sessions opened with a symposium on deep-well pumps and pumping.

"Operation and Maintenance of Deep Well Pumping Units," by J. D. CAMPBELL, Supt., Merchantsville-Pennsauken Water Commission, Merchants, N. J.

Mr. Campbell said that he would utilize the time allotted to him in commenting only on the principal essentials of good maintenance and operation of turbine type well pumps. He laid stress on the fact that well pump operation seemed so simple that costly experience had been had when unskilled men had been put in charge of well supplies. Of considerable importance was the choice of the proper grade of lubricating oils, maintaining proper oil level, and knowing when to change it. Concerning maintenance of motors of the slip-ring type, the brushes should be kept free of binding in the holders and spring tension even. The commutator should be kept as clean as possible by use of the finest grades of sandpaper—but, never should emery paper be used

Two Secretaries

Prof. Harry N. Lendall (Rutgers Univ.) and P. S. Wilson (Right) Who Is Turning Over to Prof. Lendall the Portfolio of the Secy.-Treas.

for the purpose. If worn or pitted, the commutator should be removed for shop refacing. Main fuses and clips should be cleaned periodically and, if pitted, replaced. Switch and dash-pot oil should be changed every third year, at least. Checking with the local power company or electrical manufacturer on the quality of oil so used (flash-point in particular) was advocated. The motor should be cleaned frequently with a portable air blower and leakage from oil lines and bearings, so damaging to motor insulation, should be watched for.

As to shaft and bearings (two important elements) flexible couplings should be carefully inspected for perfect alignment and the bushings (rubber or leather) replaced before too great wear is indicated. Some units, however, have the main thrust ball-bearing on the top of the motor; others have the tilting segment type (Kingsbury) bearing which runs in oil in the same housing with the radial bearing. Such bearings should have an oil change every six months and be flushed with light oil once yearly. Each time the pump is pulled for inspection or repairs, bearings should be carefully inspected and sent to the factory for checking or overhauling if doubt arises. Water used for cooling bearings or the oil in the bearing case, should not be returned to the well. Oil or grease sealed glands are preferred to the water sealed gland by most operators—corrosion and shaft scoring being the chief difficulties with water seal. Packing in the top gland of the pump shaft should be changed at least yearly to preclude hardening and costly shaft scoring.

"How frequently should a deep well turbine, which is apparently working satisfactorily, be pulled for inspection and possible repair?" was the question fre-

"Knights of the Round Table"

Jas. G. Carns, Jr., Supt. Meters, N. J. Water Co., Haddon Heights; Edw. P. Hyland, Supt. of Water and Sewerage, Moorestown; J. J. Van Brunt, Supt. of Water, Manasquam.

A. L. Sherman, Chief Engineer of Water Supply, Jersey City; Wm. G. Bank, Div. Engr. of Water Supply, Jersey City; Chrystal Brown, Supt. of No. Jersey Water Distr., Wanaque.

quently asked by operators. It was hard to answer. The quality of water and duty of the unit were the controlling factors. With non-corrosive water and maintained yields, pump pulling every three years seemed safe practice. In other cases pump pulling each fall was justified, remembering the old saying that "an ounce of prevention is worth a pound of cure." With waters of low pH value and with carbon dioxide above 15 parts per million, grey iron impellers are attacked and the key-way is loosened. Under such conditions replacements with stainless steel shafting and bronze impellers become advisable. Extreme care should be exercised in cleaning all ball-bearings and in alignment of the spiders between the discharge column and shaft tube. The main shaft-adjusting nut should be carefully checked to avoid contact between impellers and pump bowls and insure proper clearances. Naturally the pump casing, drop pipe, and shaft tube should be scraped, cleaned and given at least two coats of the best quality water-proof and non-taste producing paint. Ample drying time was important.

"Improvements in Deep Well Pumping Equipment"

In this part of the Symposium representatives of three pump manufacturers reviewed improvements in deep-well pumping equipment.

H. W. STODDART, Sales Engineer for Worthington Pump & Machinery Corporation, confined his remarks to improvements in turbine type pumps which have largely displaced other types for heavy continuous duty. To combat sand troubles, semi-closed type impellers and wearing rings had been further perfected. Concerning water and oil lubricated pumps the latter, with automatic oil flow control, had been favored because of less whip of shaft running through the oil tube containing bearings at 5-ft. spacings. For line-shaft lubrication, low viscosity oil (122 Sabolt or less) was emphasized. Combination motor and gear heads for operating from motor or standby oil or gas engines had come into demand. With bronze wearing rings and grease packed bottom bearing the pump impeller adjustment was simply made at the top of the line shaft passing through the motor. Shafts were being made of stainless steel, with thrust loads carried on ball-bearings at the head of the motor. Mr. Stoddart also stressed a safety feature, allowing the shaft to unscrew at the motor base should the motor reverse direction at any time. All of these features were illustrated by lantern slides of typical sectional drawings of Worthington pumps.

In reply to questions, Mr. Stoddart said that stainless steel shafting was vital in the bowl section. He would prefer an all stainless steel shaft but it was not essential above the bowl. For salt water pumping bearings of Bakelite and shaft of Monel Metal were frequently used.

A. W. Ross, Vice President, Layne-New York Co., reviewed some of his 25 years experience with the Layne system and pointed out a parallel between airplane and turbine well pump developments since 1925. Only since the hollow-shaft motor became available (1925) had turbine pumps for wells been extensively developed and marketed. Now, these units, improved as to ruggedness and dependability, had come to be the most economical well pumping equipment. Realizing that at 1,750 r.p.m. the water passed from pump bowl to bowl in 1/100th of a second, the importance of exact design and clearances could be realized. For waters high in CO_2 content, impellers and screens of enameled cast-iron were best. Mr. Ross, quoting from an article by Dr. O. E. Mizner, named the advantages of ground water supplies and noted that 65 per cent of American water supplies came from wells, the largest development (40 m.g.d.) being that of Memphis, Tenn. He stated that the weak spot was usually the screen, and reviewed the development of the gravel-pack type wells with capacities 10 to 20 times those of earlier types, making it possible in certain cases to replace 80 driven wells with 3 gravel-packed wells yielding a better quality of water at reduced costs for maintenance and operation.

1. *Jo. Aker, R. D. Wood & Co.;* 2. *E. T. Killam, Cons. Engr., New York City (now his own boss);* 3. *Jack Diven, Leadite Co.;* 4. *Arthur Bell, Boro. Engr., Essex Fells;* 5. *R. K. Farrington, U. S. Pipe and Foundry Co.;* 6. *C. D. Turner, Wailes-Dove-Hermiston Corp.;* 7. *W. J. Van Vleck, Worthington Pump Co.;* 8. *E. S. Gillette, Publisher of "Water Works and Sewerage."*

HENRY FOLZ, Deep Well Turbine Specialist, Byron Jackson Company, had something distinctly new to present in the way of pumping units, when he described the features of the recently developed and novel "Submersible" turbine pump, which has its motor *below* the pump bowls and the complete unit operates submerged. Mr. Folz stated that Mr. Byron Jackson had produced the first turbine type pump for deep wells in 1901. His company, realizing the advantages of eliminating column, shaft and bearing had sought a motor which could be attached directly to the pump unit and, consequently, in 1936 the Submersible Motor Pump Co. had become the property of Byron Jackson Co. With the aid of colored drawings, and slides, the novel Byron Jackson "Submersible" pump and its installation was described. The motor, which is placed below the pump bowls, is long and narrow; it operates in a bath of oil and is mercury sealed to preclude entry of water. Being submerged,

the oil runs cool and there is practically no replacement needed—some units having run five years without oil replacement. Safety devices preclude the possibility of motor start should the oil volume become depleted. The same device indicates the need for adding oil, which is done from the surface at intervals of several months only.

Mr. Folz pointed to the following features of the "Submersible": With no shaft there is less friction loss, 50 per cent of the moving parts having been eliminated; crooked wells were no obstacle and no pump house was needed over the well; operation is silent and flood damage of motor is impossible. He pointed out that no field adjustments were necessary, as the unit came ready for service from the factory responsible for both motor and pump. In cases of dug-wells or ground reservoirs, units of different capacity could be installed for automatic operation to meet seasonal load requirements. Lantern slides revealed typical installations, some with four years of operation to their credit.

In reply to questions, Mr. Folz said:

(1) "Submersibles" were now available for wells between 8 and 16 inches in diameter, with motors of 25 to 200 H.P. (2) Shaft from motor to pump required no stuffing box because it passed through the mercury seal. (3) Motor efficiency was high (that of a squirrel-cage motor) because of the cool water submerged operation. (4) Upon need of more oil the motor would kick out, and remain so until a measured volume of oil is added, such being very infrequent. (5) As to costs, in wells under 100 ft. deep the "Submersible" would be more costly than shaft drive; in deeper wells, less so.

Discussion of Capen Paper

At this point CHAS. H. CAPEN, JR., Engr., North Jersey District Water Supply Commission, presented a brief resumé of his paper "Major Water Supply Developments in New Jersey—A Statement of the Problem" which had already been pre-printed in the Journal of A.W.W.A. for September. So ineffective would an abstract of Mr. Capen's outstanding paper be that the reader is referred to the Journal for his full paper, which won so much commendation. The author closed with the questions: (1) Does the public realize the seriousness of the situation? (2) How may steps be taken to correct the deficiencies? It was Capen's paper, and the questions it raised, which resulted in the pointed discussion and the resolutions reproduced earlier in this report.

HOWARD T. CRITCHLOW, Engr. in Charge, State Water Policy Commission, highly commended Mr. Capen for his excellent production and pointed to the costliness of delaying a needed joint water supply project of 150 m.g.d. yield, designed for interconnection of North Jersey communities to be served. He pointed out that

M. W. Cowles, San. Engr., Hackensack Water Co.; Walter Spencer, Secy., So. Jersey Water Supts. Assn., Merchantville; E. Vernon Smith, Supt. of Water, Park Ridge.

Sam Gray, Supt. of Water, Montvale, N. J. (Brought His Mayor Along; Says Others Should); J. D. Campbell, Supt. of Water, Merchantville, N. J.; E. J. Wilson, Mayor, Montvale, N. J. (Promised to Help Sam Gray Speak, but Slid Out.)

legislation designed to establish an additional Water Supply District had been defeated by those communities with ample water supply at present. In New Jersey the problem was that of establishing unity, rather than a problem of engineering, and the question was what authority should handle the situation.

W. W. BENDER, President of the Elizabeth Board of Water Commissioners, was high in praise of the reservoir of information contributed by Mr. Capen. He felt that the time to act was now. It was a matter of co-operation now or condemnation later, when rush expense and possibly deficiency of supply would be the price of delay and bickering.

HARRY E. NEWELL, Mayor of Bloomfield and Asst. Chief Engr., National Board of Fire Underwriters, expressed admiration and appreciation to Mr. Capen for his illustration of the value of interconnection in water supply development. His thought was that the information should be put in shape for public consumption and use in countering the opponents of proposed water supply legislation. He questioned the wisdom of water supply engineers longer remaining silent in the face of political blockage, if we were to expect the public to continue to have faith in the engineer.

W. J. ORCHARD, A.W.W.A. Director and member of the Water Supply Committee, said that the water supply question was a political "hot potato" and the gubernatorial candidates were dodging the issue. He thought that all candidates for office should be asked to commit themselves on this question *before* election. It was at this juncture that someone suggested the drafting of resolutions which were later offered, discussed and passed.

Superintendent's Round Table

(EDW. P. HYLAND, *Presiding*)

(Unfortunately, the lateness of the hour made it necessary to hurry the Round Table so that little or no free discussion was permissible.—ED.)

Sterilization of Mains

E. VERNON SMITH, Supt. of Public Works, Park Ridge, N. J., opened discussion on this topic by saying that he, like many other superintendents, formerly questioned the necessity of sterilization of new mains, but had now become convinced of its value through experience. Attempts to sterilize through fire hydrants had not been effective. The practice of placing sufficient high test hypochlorite—"H.T.H."—in the section to be sterilized, to produce a solution containing 50 parts per million available chlorine, followed by slow filling, had proved effective and simple. A contact period of 24 hours, followed by flushing, produced coli free samples whereas in previous experience 4 to 5 months had been required for b. coli to clear up.

R. M. ROPER, Engr. and Gen'l Mgr., Board of Water

"Pipes to the Right of Him; Pipes to the Left of Him"
Behind the Grand-Dad of Pipes (Left) Is Ralph Shaw, "U. S. Piper." That on the Right Belongs to N. J. Kenney, President National Meter Co. Between Is Boyd N. Bennett, President Northeastern Water and Electric Co.

Commissioners, East Orange, N. J., having used both liquid chlorine and "H.T.H.," preferred the latter for simplicity sake. The dry powder was placed in each section of pipe during laying. Later, section by section, the main was filled slowly, followed by 24 to 48 hrs. contact and a thorough flushing.

S. F. NEWKIRK, JR., Supt., Board of Water Commissioners, Elizabeth, N. J., then read that part of A.W.W.A.'s Committee report on the Laying of Cast Iron Pipes which pertains to Main Sterilization. In it the following recommendations are set forth:

(1) All new means require flushing and sterilization.
(2) Preferences of method, in order, are (a) injection of chlorine water; (b) chlorine gas during slow filling; (c) hypochlorite solutions; (d) placing dry hypochlorite in the pipes and later filling.
(3) Point of application; Entrance to section on low head side of gate valve, opened just enough for slow filling at rate to insure 40 to 50 parts per million of available chlorine in the filling water.
(4) At the far end 5 p.p.m. of residual chlorine should be present in the bleed water, after which a contact period of 3 hours or longer should be allowed prior to flushing.
(5) A thorough preliminary flushing would precede the chlorination procedure to ensure its effectiveness.

Delinquent Bill Collections

SAMUEL GRAY, Water Registrar, Montvale, N. J., recounted the success had by Montvale in requiring $10.00 deposits on meters, use of the customer-contact, with 4 per cent interest allowed on deposits. After seven years of the scheme "no single penny was delinquent." Mr. Gray urged operators to get their Mayors out to the Association meetings and cited the fact that he had found a distinct good from it, and had his Mayor along with him. Mayor Wilson, of Montvale, took a bow and we snapped his picture for these pages.

Meters—Their Design, Installation and Maintenance

JAS. G. CARNS, JR., Supt. of Meters, N. J. Water Co., Haddon Heights, in discussing meter design, stressed the value of ruggedness, interchangeability of parts and useful life of the instrument. As to selection of proper size of meter for a service, the customer must be satisfied—but, the common fault seemed to be the installation of oversized meters. The only correct method of selection had proved to be checking up on demands through a recording instrument for the period of one week, and disregard for size of installed service line, which might advantageously be oversized. Instead of compound meters, Mr. Carns preferred battery installations, because of greater accuracy (as a rule) and ease of testing. As to location, curb installations had proved preferable for ease and lower continuing cost of reading and the desire not to have readers enter homes. His company offers to supply customers with a box-key, when requested, and free testing is offered complainants. Meters are set 24 in. below top of curb boxes 44 in. deep. In discussing sustained accuracy, Mr. Carns pointed out that 30 per cent of the water drawn in the home was at rates of less than 1 gal. per minute and, therefore, sustained accuracy on low flows was a paramount consideration. New meters, registering 96 per cent accuracy on flows of ¼ g.p.m., have been known to drop to 80 per cent accuracy on such flows in a short period. Fortunately, repaired meters could be brought back to 94 per cent accuracy on the low flow. The orifice test had not been found as dependable as the weighing or volume test. Mr. Carns expressed the opinion that, in checking up on water not accounted for, the practice of allowing 2 to 5 per cent meter accuracy was not sufficient allowance, based on observation.

In repair shop practice, if repairs run to more than 60 per cent of the cost of a new meter the old is scrapped. The chief weakness of all meters seemed to be in the stuffing box. Replacement of worn balls was practiced rather than shimming up to effect only a temporary gain. The program of routine testing and repairing automatically covered every domestic meter at 5-year intervals. In this routine, only one repair man was needed in the shop, with three other men on the work. Since 1928 the average registration, recorded per meter, has gradually increased until now the gain had reached 10 per cent.

WALTER SPENCER, Ass't Supt., Merchantsville, N. J., pointed out that few meters registered flow of under 1/10th gal. per min. and considerable water in the aggregate could be taken for residence air-conditioning during night hours without registration.

Copper Pipe and Fittings

KENNETH VAN BRUNT, Supt., Water Department, Manasquam, N. J., recited experiences with copper-tubing for services with a water of pH 5.2 or thereabouts, conducive to crenothryx deposits which choked lead and iron service pipe in a few years. On the copper-tubing some slime growth had appeared, but there had been no stoppages during 12 years of use. In marshy soil, so destructive to iron pipe, the copper had corroded but little. In replacing old iron services the tubing, attached to one end, is pulled through as the old pipe is withdrawn with a jack pipe-puller. In new work through clay an auger is used for a distance and iron pipe is pushed through and then pulled from the other end with the connected tubing following. Flared end compression type connections, Mr. Van Brunt had found preferable to sweat-soldered couplings and fittings underground.

"Chlorinating Coli Crucifiers"
Lee Purcell, Chemist, Wanaque Supply; John Radcliffe, Chemist, Elizabeth Water Co.; A. E. Griffin, Chemist, Wallace and Tiernan Co.

He cited the fact that leaks in gravel and sand had churned sufficiently to create a wearing through of old lead services in brief time. Type K heavy annealed copper tubing had proved overall the most preferable service material yet tried, justifying the cost in the face of the considerably higher initial cost.

Electrolytic Corrosion

M. W. COWLES, San. Engr., Hackensack Water Co., New Milford, N. J., in recounting progress being made by the Joint Committee on Grounding to water pipes, said that the conclusion had been reached that grounding of the neutral wire of house wiring systems to water pipes is an essential safety measure. However, a slight amount of resistance at the neutral connection would serve as a dam to divert stray (leaking) current flow from the water pipe—frequently 6 to 12 amps. The theory that alternating current causes no corrosion damage had been exploded, and it seemed certain that galvanic action between dissimilar metals had been stimulated by the A.C. current. In view of the many variables in the field, laboratory studies had been started to obtain better controlled observations.

Control of Pollution of Public Supplies

"State Supervision of Watersheds," by H. P. CROFT, Chief Engr., and D. M. DITMARS, Ass't Engr., N. J. State Dept. of Health, Trenton, N. J.

This paper, read in abstract by Mr. Ditmars, was presented to acquaint operators and engineers with the powers and duties of the N. J. State Department of Health in the supervision of watersheds and streams used as sources of public water supply. In a review of the history of state agencies having authority over stream pollution and water supply it was interesting that at times there had been more than one in New Jersey, with split or overlapping authority, lack of cooperation, and confusion resulting. Although the State Board of Health (established 1877) was already in existence, a State Sewerage Commission (created in 1899) for several years was the source of confusion in court cases as to the proper authority in matters pertaining to stream pollution. Outcome: In 1908 the powers of the Sewerage Commission were transferred to the State Board of Health, which subsequently (1915) became the State Dept. of Health.

Concerning pollution by industrial wastes—a New Jersey Act of 1921 requires that the manufacturer expecting to use a stream shall obtain a permit from the State Department of Health before locating on such stream if contributary to a public water supply. A case was cited, wherein a manufacturer seeking to locate above Trenton on the Delaware, having been refused a permit, had sought one from New York to establish location across the river. Cooperation between the Health Departments of the two states prevented an otherwise embarrassing situation to the New Jersey authority, to Trenton, and other municipalities taking public supply from the Delaware River.

From experiences in New Jersey, three of the conclusions reached by the authors follow:

(1) That stream pollution control should be lodged in that agency charged with supervision of the purity of the public water supplies—existing or potential—if split authority and confusion are to be avoided.

(2) That the statutory limitation in bonded indebtedness of New Jersey municipalities does not constitute a defense in the matter of stream pollution abatement.

(3) That the anti-pollution Act of 1921 serves to prevent pollution, whereas, the earlier public health laws are sufficient in respect to abatement of pollution.

"Pollution of Public Water Supplies by Bathing," by W. C. MALLALIEU, San. Engr., Bureau of Water, Jersey City, N. J.

Mr. Mallalieu presented a form of progress report covering his investigations into the effects of bathing in streams and reservoirs serving as sources of public supply. He quoted those laws of Massachusetts and Connecticut, which prohibit bathing in potable waters. He then referred to attempts by the N. J. Department of Health to prohibit bathing in public supply sources, but these had been largely negatived by a more recent legislative act which permits such use of public supply sources provided no trespass is committed.

Not ready for a final report as to the outcome of his studies, Mr. Mallalieu cited data on one important supply affected, showing the rise and fall of b. coli index with the bathing season. He pointed out the difficulties through laboratory proof that a health hazard exists, but that it was not difficult to picture the filth introduced by bathing, and to realize the potential dangers, that are clearly indicated by standard methods of water examination at the point of bathing and beyond.

W. W. BRUSH, Editor, "Water Works Engineering," stated that while in charge of the New York Water Department no evidence was found to indicate that bathing created pollution which could be considered of hazardous nature to the health of water consumers. At one time arrests were made on promise of prosecution by the City Health Department, but when the cases came up evidence of danger to health could not be produced by the latter.

(We understand that an important case is pending, wherein a North Jersey municipality is bringing suit against a company operating a bathing place on the watershed. The evidence gathered by Mr. Mallalieu in this connection, and the outcome of the litigation to stop such use of public water supply sources, holds much of interest and consequence to those responsible for cleanliness and safety of public water supplies.—ED.)

1. C. L. Bogert, Cons. Engr., New York; 2. J. H. Faulks, Neptune Meter Co. (Golf Chairman); 3. Geo. Weighardt, Hydraulic Engr., West Englewood (Trustee); 4. Harry Freeburn, District Engr., Pa. State Dept. Health; 5. "Vic" Arnold, President Phoenix Meter Co.; 6. A. S. Hobby, Cons. Engr., Newark; 7. Jim McKague, National Meter Co., Brooklyn; 8. "Ross" Scott, Dresser Mfg. Co., N. Y.

"Chloramination"—(Chlorine-Ammonia Treatment)

"Chlorine-Ammonia Treatment of the Wanaque Supply," by LEE T. PURCELL, Chemist, North Jersey Water Supply Commission, Wanaque Reservoir, N. J.

Mr. Purcell reviewed the history of the Wanaque Reservoir and the difficulties encountered during the first few years of reservoir aging. Algae, high color, deoxygenation of bottom strata, reservoir turnover, bacterial growths in the mains, all contributed to create water very distasteful to consumers. At this time (1930) ammonia-chlorine treatment was just getting its start and was immediately put to test at Wanaque, but with none too marked success and consequently discontinued. In 1933 it became necessary, because of bacterial aftergrowths in the system, accompanied by markedly increasing chlorine demand, to raise the chlorine dosage and, with it, the ire of the public because of tastes. It was then that the ammonia treatment was again resorted to (Cl — NH_3 ratio 4:1) and it was found that, without consumer complaint, the residual chlorine could be boosted to four times that produced by chlorine alone. Likewise, the higher residuals persisted far into the pipe system (8 hrs. beyond treatment) and marked bacterial improvement of tap samples promptly resulted.

The scheme, as eventually perfected at the Wanaque Reservoir, consists of adding the chlorine to the water leaving the reservoir (pH. 7, plus or minus) and down the aqueduct (5 minutes later) lime is added to boost pH. values to between 8.4 and 8.6, automatic control being the order. Thus the residual chlorine is changed to hypochlorite. Just beyond the ammonia enters—only sufficient to convert the *residual* to mono-chloramine. Thus, it is, that the ratio of 1 ammonia to 4 *residual* chlorine produces a marked and desired ammonia economy. And, *rapid* sterilization precedes the slowing-down lime and ammonia application, satisfies the chlorine demand, and results in a markedly subdued dissipation of the residual over that which takes place when ammonia is added first to organic waters and thereafter the chlorine. [In effect the Wanaque method is one of high, rapid chlorination and "dechlorination" by producing tasteless chloramines, from the residual, with ammonia.—ED.]

Mr. Purcell showed lantern slides of curves, indicating the appearance of aftergrowths in the system and rapid loss of residual chlorine as compared to the results from the heavy chlorine-light ammonia treatment. He pointed out that in cold weather (after December) the ammonia is discontinued, because of non-necessity and the drop in efficiency of "chloramination" noted during water temperatures below 5 deg. Centigrade, in the pH. range of 8.4 to 8.6 requisite to corrosion checking. The months of pronounced need at Wanaque had been the period August-December. That practically all of the ammonia added (90 per cent) seemed to be recoverable as free ammonia (tap samples) and only a suggestion of nitrites had been produced, proved an interesting disclosure. Mr. Purcell stated that the after-treatment with ammonia had made chlorination genuinely effective and practical during the critical season.

[Mr. Purcell's paper will appear in full in a near-future issue of WATER WORKS AND SEWERAGE.—ED.]

JOHN L. RADCLIFFE, Chemist, Elizabethtown Water Company, Elizabeth, N. J., contributed his experiences with ammonia-chlorine treatment at two plants. In one instance pre-ammoniation and prechlorination, with ratios of ammonia to chlorine 1:4 in warm weather and 1:10 in cold weather was the practice. After 10 to 48 hours in coagulation basins no residual reaches the filters, but the applied water continued essentially sterile. After passing basin and filters 50 per cent of the ammonia remained to serve in post-chlorination. Maintenance of residuals 4 to 6 hours further out in the distribution system than possible with chlorine alone had been experienced. Mr. Radcliffe pointed out that residuals carry through to the far ends of the mains in winter but not in summer. He also remarked on the value of "prechlorination" in cold weather, when low temperatures retard the speed of chloramine sterilization.

A. E. GRIFFIN, Research Engineer, Wallace & Tiernan Co., stressed the advantages and economy of adding ammonia after the chlorine (based on residuals) where possible to do so without producing by-product tastes, and discussed the effectiveness of sustained residuals in the system to attack organisms coming into the tender bloom-stage. It was his opinion that, in general, the practice was to add more ammonia than was necessary, and advocated cut and try procedures to determine the minimum ammonia requirement for the specific effect sought—where permissive, post-ammoniation such as has served Wanaque so well.

(Adjournment)

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Morse Filter Plant for Carnegie Steel

A contract has been awarded by the Carnegie-Illinois Steel Corporation for a complete water works system for the new Irvin Works between Dravosburg and Clairton, Pa. The contract, on which The Rust Engineering Company is both designer and contractor, will call for an expenditure of approximately $800,000.

It will be one of the largest water works ever built purely for industrial use and will have an initial capacity of 36,000,000 gallons per day, with provision made for an ultimate capacity of 72,000,000 gallons per day.

Water will be taken from the Monongahela River through a reinforced concrete open intake. Trash gates at the entrance will remove heavy refuse, while traveling screens will pick up light refuse, such as leaves.

A primary fully-automatically controlled lime treatment system will be provided to neutralize the acid content of the river water.

The pumps will be electrically driven by 1,250 horsepower A.C. motors. A single stage centrifugal pump will be mounted on each end of the motor shafts. These will be operated in series, so that the water will be discharged from the first pump at a pressure of 150 pounds per square inch and will be raised to a pressure of 200 pounds per square inch by the second pump.

After passing through the pumps, the water will go through automatic strainers to remove all foreign matter .024 inches in diameter or larger.

The water will be elevated 450 feet through a 42-inch line to a steel reservoir on the hill above the plant, with a capacity of 3,750,000 gallons.

Part of the water will be delivered directly from the reservoir in a raw state for descaling and cooling. Water requiring further refining will pass through an all-steel filtration plant of the Morse type, which was developed by the late Robert B. Morse for the Washington Suburban Sanitary District—and described in the June 1934 issue of WATER WORKS AND SEWERAGE.

SLUDGE GAS POWER ON SEWAGE WORKS

Recent Progress in Great Britain

By JOHN D. WATSON
Consulting Engineer
Ruislip, England

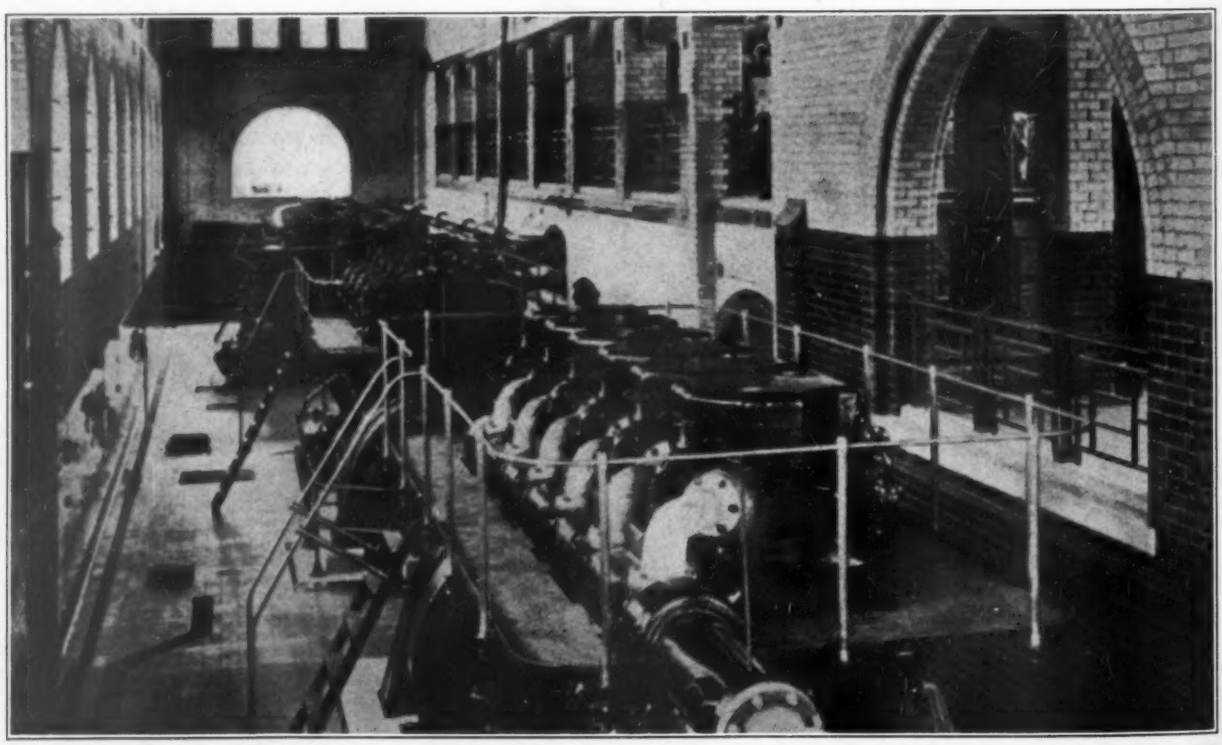
AS MIGHT be anticipated, the sludge problem on the sewage works of the large inland towns of Britain has long been a formidable business. The only really satisfactory means of disposing of it in the prevalent damp climate has heretofore been by lagooning and trenching, and that requires a large area of land often difficult and costly to acquire. It was, in fact, just those difficulties confronting the responsible engineers of the Birmingham works, which now serve a population approaching two millions, that led to investigations into sludge digestion which is now a common feature of most works.

Birmingham Leads the Way

Seeing that the process evolved considerable volumes of gas with a calorific value well over 600 B.t.u. per cu. ft. the installing of a 34-H.P. gas engine at those works in 1921 was a more or less logical step. With the comparatively large amount of power now required in the operation of modern sewage works with activated sludge systems, those like the recently completed scheme of the West Middlesex Joint Sewerage Board at Mogden on the outskirts of London are equipped with quite large power plants of this class. At the Saltley works of the Birmingham Tame and Rea District Drainage Board, there are now eight such engines.

The largest units here follow the policy adopted at Mogden, in being convertible units which can run on oil at any time the gas supply should prove deficient. The earlier installations at Birmingham and some of the smaller plants in Britain and the Dominions (like the one at Gravesend) have engines of the standard industrial horizontal or vertical trunk piston class with an output of perhaps only 30 to 40 H.P., but the large schemes have installed multi-cylinder units of the modern high speed enclosed class direct coupled to generators. The largest at Birmingham (see cut) produces 400 Kw. on a gas consumption of 20.8 cu. ft. per hour, which with gas of a calorific value of 625 B.t.u. per cu. ft., represents the very creditable performance of 8,800 B.t.u. per B.H.P./hour. These works are now wholly independent of any outside source of power.

Sludge digestion at these works, and the majority of those in this country employing the process, operates on lines with which the readers of these columns will be fully conversant in that it is carried out in relatively deep circular concrete tanks of the appropriate type with floating covers, the process being sometimes assisted by mechanical circulation of the sludge by a screw pump working in a vertical centrally disposed tube (Fig. 1). The principal feature, however, in the present connection is the assistance of the process by heat and as this, or the major portion of it, is available from the waste heat of the jacket water and exhaust gases of the engine, the whole process can be carried out with considerable economy. The cycle of operations is shown in the diagram in Fig. 2 and while applicable generally, refers in the main to what is being done at the Birmingham Corporation's Coleshill plant which deals with a D.W.F. of 2 m.g.d. Here the crude sludge is treated by digestion



Four of the Eight National Gas Engines Serving Birmingham's Treatment Works—These Being in the Saltley Power Station.

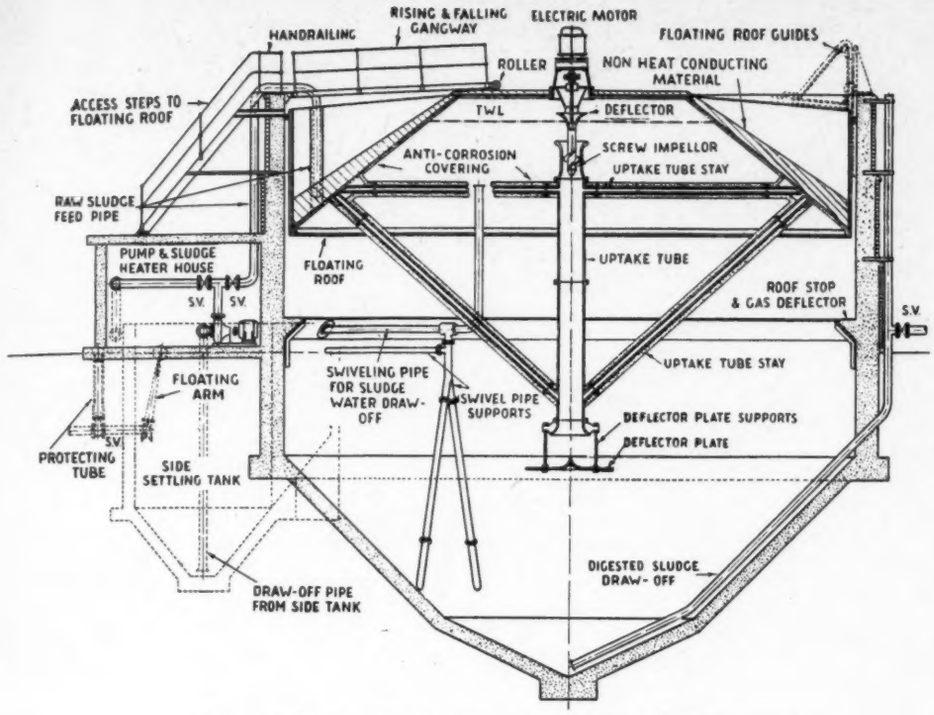


Fig. 1—Sludge Digestor of the Ames Crosta System

in two stages in separate tanks, the surplus activated sludge being further dealt with.

At this plant there are eight tanks of which five are in the nature of "primary" tanks measuring some 61 ft. long by 31 ft. wide and are 16 ft. deep. They are designed to hold the sludge for 50 days and they are fitted with gas collectors constructed in the form of flat domes of corrosion resisting steel. They are partly submerged in the sludge and they rise or fall according to the volume of gas they contain. During digestion about 30 per cent of the solid matter actually disappears, part of it being converted into gas and the remainder being drawn off as liquor. Keeping the tank contents warm considerably assists the process and to do this the jacket water of the engines is first heated to around 130 degs. F. by the exhaust gases. This hot water is then cooled by the *alkaline water*, which is drawn from the secondary digestion tanks. The engine jacket water is re-used for its own purpose while the heated alkaline water is returned to the primary tanks in sufficient volume to maintain the most satisfactory pH value in them and also to maintain the most suitable temperature. The latter may vary under different climatic conditions and with different compositions of sewage, but so far as the works cited are concerned keeping the digestion tanks at around 74 deg. F. has been found to increase the yield of gas very considerably.

On account of the high temperature of the engine exhaust gases, which averages some 1130 degs. F., a large amount of waste heat is available from them, but even if that should fall short of requirements, there may still be some surplus gas to burn in a tubular heater.

As might be inferred, apart from the fact that a practically standard type of gas engine has been found to serve the present purpose quite well, no attempt has yet been made to standardize the necessary digestion tanks. Some of these take the form of ferro concrete rafts meauring 20 ft. x 10 ft. floating on sludge which is 12 ft. deep. From conical domes in the center of these rafts, of which incidentally there are some 600 at Birmingham, the gas is drawn off by flexible tubing connected to ring mains. These rafts weigh eight tons, giving a gas pressure in the mains of 18 in. W.G. which is reduced to 2 in. W.G. by mercury governors at the engine house.

In Fig. 2 is shown a rather more recent system. As already noted, the gas collectors here are 61 ft. x 31 ft. and they ride up and down guides in the tanks being 5 ft. deep at the center and 4 ft. at the sides. They weigh 16.5 tons and give a gas pressure of 4 in. W.G. They are not, however, formed like the concrete collectors as pontoons to obviate the possibility of submergence, but are prevented from sinking by the presence of the gas beneath them.

Results in Practice

The foregoing remarks apply mainly to what is being successfully accomplished at two or three works in the Birmingham area, but the other installations mentioned have proved equally successful. At Burnley, for instance, where there are two 150 H.P. sets, each engine uses around about 30 cu. ft. of gas per K.W.H. according to the load. When on full load one engine will use about 3,000 cu. ft. of gas per hour, the cost being about 3/- based on a charge of 1/- per 1,000 cu. ft. of gas having a calorific value of 500 B.t.u. per cubic foot gross. These engines can run in parallel with the public gas supply when required to do so.

The units at the Motherwell and Wishaw works are rated at 140 B.H.P., these being 4-cylinder sets (9 in. x 13 in.) running at 500 r.p.m. The installation was completed in the latter part of 1934. At the Dartford works of the West Kent Main Sewerage Board, two engines develop 250 H.P. each at 375 r.p.m. Here there are three comparatively large circular digesting tanks capable of producing over 400,000 cubic feet of gas per 24 hours of exceptionally high (715 B.t.u.'s gross) calorific value. Each engine now consumes 46,000 cubic feet, so that here is a large surplus available.

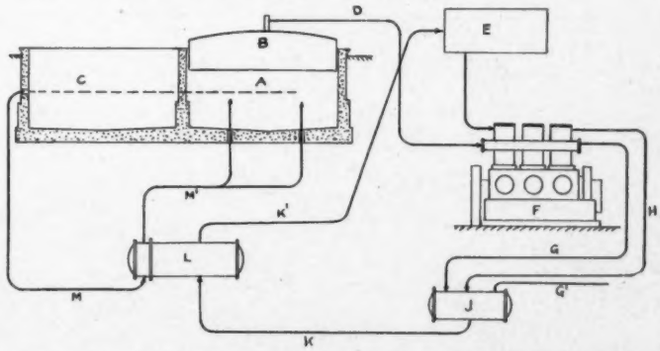


Fig. 2—Schematic Diagram of a Gas-Engine Power System with Heat Utilization: (A) Primary Digesting Tank; (B) Collector; (C) Secondary Digesting Tank; (D) Sludge Gas; (E) Cooling Water Tank; (F) Engine; (G) Exhaust Gas to Cooler; (G') Exhaust Gas to Atmosphere; (H) Cooling Water; (K) Heated Water Flow; (K') Heated Return; (L) Water Heater; (M) Cold Alkaline Water; (M') Hot Alkaline Water.

The digestion system here, known as the Dorr-Oliver is one claimed to produce a sludge which, unlike most, is a really good fertilizer which will command a fairly ready sale. This involves three circular tanks 85 ft. diameter x 29 ft. deep in which the sludge is kept in slow motion top and bottom. That is to say as the sludge is fed in from the top, the upper arm of an agitator serves to spread it and also to break through the scum to allow the better escape of the gas. The lower arm feeds the digested sludge to a central outlet in the bottom of the tank to which it automatically feeds as digestion proceeds. The necessary heat here is obtained from a gas fired boiler while the gas used in both engine and boiler is collected in gas domes located in the center of the roofs of the digesters whence it is led for storage, to a gas holder of orthodox design.

Both the Coatbridge and Gravesend works mentioned above, while relatively small ones, are serving their purpose equally well. At Gravesend there is a 45-H.P. horizontal set driving a compressor while at Coatbridge there is a 27-H.P. engine generating all the power required for the sludge digestion system. The Johannesburg, S. Africa, scheme, also commenced in quite a small way with a 25-H.P. engine of the aforementioned gas/oil convertible type, though the plant has now been extended by the installation of 2 6-cylinder, 220-H.P. units.

It must be recognized that these plants have proved perfectly satisfactory in every instance. Only minor adjustments to the standard types of gas engine are required, their rating is high owing to the richness of the gas, there is no smell while the heat recovery makes for the highest thermal efficiency and complete independence in most cases of outside sources of power.

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Green Bay, Wis., Enlarges Sewage Works Gas Engines Installed to Pump Sewage

In the November, 1934, issue of WATER WORKS AND SEWERAGE was described the new sewerage system and sewage treatment plant of Green Bay, Wis., Mr. Jerry Donohue, consulting engineer of Sheboygan, Wis., being the author of the article.

Since that time the Green Bay Metropolitan Sewerage District has extended its sewer system to take in the Fox River District in addition to the East River District, served in the original design. The enlarged treatment plant is shown in the accompanying picture. It provides primary clarification and separate sludge digestion.

In the enlargement project an important feature was the installation of gas engines to produce power for lifting the sewage from the deep interceptor sewers to the plant. In 1935 and 1936 the cost for electric power was $13,108. Such a figure represented an abnormally high percentage of the total cost of operation, which seemingly could be curtailed appreciably by installing a floating covered digester, a gas holder and gas engines. To date the gas has proved sufficient for lifting all but high storm flows the required 50 ft. to the sedimentation units.

In the accompanying picture may be seen the spherical gas storage unit, which might be termed the "bubble of progress" in sewage treatment. This, because those plants equipped with gas holders and gas engines are the progressive and the most economically operated plants. The Hortonsphere at Green Bay's plant, of 50 ft. diameter (178,000 cu. ft. gas capacity), was selected as the correct size to store up surplus gas, based on gas engine power requirements to pump sewage for a number of hours without taking gas direct from the floating-covered digester. Also, to amply take care of peak loading requirements during all but excessive storm flows.

The pressure storage sphere operates under pressures of 10 to 30 pounds per sq. in. depending upon the volume of gas contained, all surplus gas not being consumed immediately by the engines being pumped to storage automatically. This gas bubble floats on the system very much as a water reservoir does. At the present the plant's average gas production is reported to be 5,000 cu. ft. per day in excess of normal demand for pumping.

▼

National Water Supply Survey Extended

The U. S. Department of Commerce last year made a survey of water supply facilities which covered the larger cities of the United States.

The purpose of this survey (reported upon before A.W.W.A. in June) was to determine the availability of municipal water supply for air-conditioning. It pointed to the weak spots in many important cities, where the system was not in condition to stand the seasonal peak loading created by air-conditioning requirements, and recommended betterments.

The 1936-'37 study covered cities of 100,000 population and upwards. The extended survey, now planned, will now cover all cities above 20,000 population.

Green Bay's Enlarged Sewage Treatment Works (The Jerry Donohue Engineering Co., Engrs.)

SEWER MAINTENANCE PRACTICE OF NEWARK, N. J.

In Newark, N. J., a system of continuous routine sewer inspection and cleaning has been evolved that has been found, through actual practice, to be well worth while.

With 360 miles of sewers to maintain, an inspection crew of six men carry on a regular schedule which insures careful inspection of *all* sewers at least once a year. Two men, working together, check the condition of the smaller sewers. On the larger sewers a four-man crew handles the inspection. On these sewers the inspector walks through the sewer itself with an electric battery hand-lamp and carefully inspects conditions.

To guard against danger to men in such sewers, both from toxic gases in some locations, and from lack of oxygen even where no toxic gases may be present, all crews are provided with a compact portable air blower. The method followed is the following.

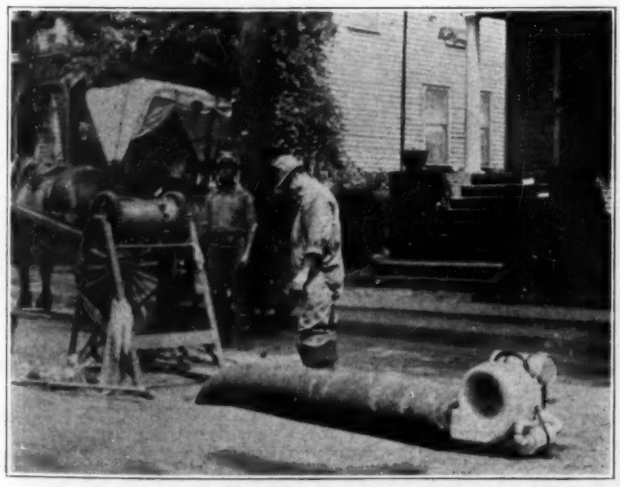
Two adjacent manholes are opened and the blower is set up to force fresh air into one of these manholes. This air, blown through the section of sewer between the manholes, clears all gas out through the other open manhole and puts oxygen in. Since the little portable blower units (manufactured by Homelite Corpn.) which are complete with built in gasoline engine, weigh only 70 pounds, they are easy to move around.

Based on reports from the inspectors, a schedule is made up for the cleaning crews. This schedule is made so that crews may go from one location to the next without lost time and with the shortest routing from job to job.

Cleaning Methods

The smaller sizes of sewers are cleaned by dragging a swab through them. These swabs, of a design original with the Newark Sewer Department, are made up in the shop in the different diameters required for different sized sewers. The swabs consist of a bole of wire wound on a steel bar core. Holes are drilled through the bar and several bolts or pins are placed through, as anchors, to hold the outside parts of the swab. On this core is wound discarded wire of all kinds (fence wire, hay wire) until a bobbin shaped bole of the proper size is formed.

For cleaning operation a windlass is set up at each of two adjoining manholes. Then with sewer rods, the cable is run through and attached to one end of the swab, and the cable from the upper windlass is attached to the other end of the swab. The swab is then pulled through the sewer from the higher to the lower end. A hose is attached to a convenient hydrant and water is turned into the upper manhole to flush behind the swab. Roots up to 72 foot length have been pulled from sewer pipes with these swabs.



One of the Handy Little Homelites at Work

The larger sewers are cleaned by sending men down into the sewer to shovel dirt into a wooden pail, carry the pail to the manhole and then hoist it to the surface. Here again the little Homelite comes in handy to insure the safety and comfort of the men. The department has had experience, some years ago, with men being overcome by gas in sewers but, since equipping both the inspection and cleaning crews with blowers for ventilation, there have been no men in this department overcome by gas or suffocation. The cleaning crew for the large sewers consists of seven men, including the driver of the dump truck.

As a result of regular routine inspection and cleaning, no great accumulations are ever present in even the largest sewers. The Newark sewers are *kept* clean—not cleaned *after* trouble has developed. This policy has been found to pay in actual cost of maintenance, as well as in the better service provided.

▼

"W. W. & S." Gets New Title (A True Story)*

In the offices of advertisers and advertising agencies, WATER WORKS AND SEWERAGE is identified generally by the initials "W.W.&S." or "W.W.S." Now the story—

Recently a new "steno" in the office of a well-known advertising agency in Chicago looked archly at the copywriter who had just handed her a batch of ad copy marked—For "W.W.&S." What magazine is this? Oh! I know, she said—"WINE, WOMEN & SONG."

Her interest fell perceptibly when she learned that she was wrong, but—that "a rose would smell as sweet by any other name." She hasn't been persuaded, however, that "Water Works & Sewerage" can ever mean anything in her young life except bathrooms, kitchens and "smelly things" that run under streets.

*From J. R. Armstrong, Vice-Pres., Russell T. Gray, Inc., Chicago.

▼

"Results of Municipal Lighting Plants" A Review

Under this title, "Results of Municipal Lighting Plants," the Burns & McDonnell Engineering Company has issued the 1937 (fifth) edition of an electric rate book showing what 511 representative cities pay for electricity under public ownership.

The volume of 230 pages is a unique and informative record of the rates, earnings, operating expenses, profits, kilowatt-hour production, valuation, and other information pertaining to the use and cost of electricity. City officials, operators and managers will find in it much of value. It is the only record available and published covering municipal electric plants and their recent rate changes, which have been many.

The book may be procured at a cost of $2.00, prepaid, by writing the producers, Burns & McDonnell Engineering Company, 107 West Linwood Boulevard, Kansas City, Missouri.

Eureka!

"I have found it"—yes, that's what Archimedes said when he found the way to determine the gold content in Hiero's crown!

You can say it too, when you discover how easy your Christmas shopping can be made by sending WATER WORKS AND SEWERAGE to a friend who would appreciate it—a pleasant reminder every month of the year.

Just send us the names and addresses of the friends you would like to have receive the magazine as your Christmas gift. A Christmas card will be sent in your name to notify them of the gift.

Send in your order NOW—and cross from your list the names of those to whom you have decided to send this extremely valuable gift.

Special Christmas Gift Offer

2 GIFT SUBSCRIPTIONS FOR $3.00

For Each Additional Subscription Add $1.00

WATER WORKS & SEWERAGE,
400 West Madison Street,
Chicago, Illinois.

Gentlemen: I enclose $.....Please send the following gift subscriptions with an appropriate Christmas card, in my name:

Name _____ Name _____

_____ _____

Address _____ Address _____

Name _____ My Name (sender) _____

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Address _____ _____

Name _____ Name _____

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Address _____ Address _____

One of two 5-foot revolving fine disc screens designed and built by Krajewski-Pesant Mfg. Co., New York, for the United States of Venezuela for purification of sewage at Leper Colony at Cabo Blanco, Venezuela. The entire slotted discs are made from 3/16" EVERDUR Metal slotted with 1/32" wide x 2 1/2" long slots which are relieved on the effluent side to permit a high orifice coefficient. The solids entrained in the sewage are retained on the surface of the disc and during each revolution are brushed into receiving hoppers for final incineration. . . . The cone also is made of EVERDUR, together with all the fastening screws and bolts.

ANACONDA
from mine to consumer

NON-RUST

Everdur* Metal used in revolving screen for Venezuela

Uniformly excellent resistance to corrosion in contact with various liquids makes EVERDUR preferred for sewage plants

Engineers who have studied the performance of EVERDUR Metal in sewage treatment attest its value for many uses...including slide gates, weir plates, supporting bolts, baffle plates, screens and other metal parts exposed to corrosion.

EVERDUR for this purpose is a copper alloy which combines the strength of steel with unusually high resistance to corrosion. It is readily fabricated by all methods — including welding. Since 1927 Everdur Metal has been chosen for many sewage applications. Data on typical installations mailed on request.

*EVERDUR METAL—EVERDUR is a registered trademark identifying alloys made exclusively by The American Brass Company. 87887

Anaconda Copper & Brass

THE AMERICAN BRASS COMPANY, General Offices: WATERBURY, CONNECTICUT

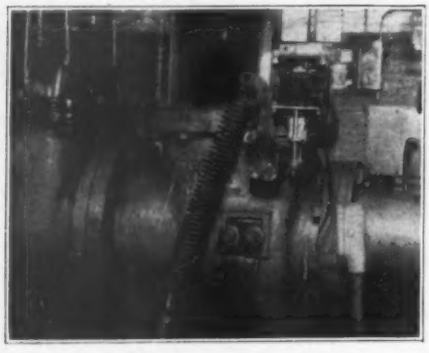
Offices and Agencies in Principal Cities . . . In Canada: ANACONDA AMERICAN BRASS LTD., New Toronto, Ont.

EQUIPMENT NEWS

Rensselaer Quiet Closing Check

Rensselaer Valve Company of Troy, N. Y., has recently announced their new Clearway Quiet-closing Check Valve, designed to reduce head loss and to eliminate check slam upon pump shut down.

The design embodies a well constructed check valve of the swing type on which is mounted a lifting-cylinder, a closing-spring and a holding solenoid, the terminals of which are connected across the pump motor circuit.



Rensselaer Quiet Closing Check Valve

It its operation, which is fully automatic, the check-valve gate is forced from its seat as the pump comes up to speed, cutting in the hydraulic lifting-cylinder, located on the other side of the picture here shown. This cylinder forces the gate to the wide open position and out of the line of flow of water. The gate is held rigidly in this position by the holding-latch and solenoid.

On pump shut down, or in the event of power failure, the solenoid is automatically de-energized, the holding-latch (rear of picture) releases, and the gate is carried quietly and positively to its seat by the closing-spring which is visible. By the proper adjustment of the closing-spring, the gate can readily be timed to reach its seat just as the water column in the discharge line comes to rest. The result is positive elimination of slam and reduction in pipe line surge. A feature of the new check is low head-loss and elimination of wear on the flap assembly

For a clear-cut illustrated description of this interesting slam-less check, ask for Bulletin "R." Address Rensselaer Valve Co., Troy, N. Y.

▼

Byron-Jackson's "Submersible" Pump

Something unique in deep well pumps is the Byron-Jackson "Submersible." It is a turbine pump requiring no drive shaft beyond that directly connecting the motor, beneath, with the pump above. Both motor and pump operate completely submerged. The novel elongated water-tight and mercury-sealed motor, operating in oil filled case and located *beneath* the pump, is fed electric power through a lead covered steel armored cable from a switch box at some convenient location above ground—there being no pump house required.

"Submersible Unit" Complete and Ready to Lower (Man's Hand Is on the Motor)

An outstanding (somewhat startling) development in deep-well pumping, the installation comprises connecting the complete factory-assembled pump-motor unit to the drop pipe, and lowering away to the desired depth. The column (drop) pipe is suspended from the surface-plate, resting upon the foundation. One feature of such installations is the non-essentiality of straight-hole wells, because of the absence of drive shaft and its tube and, too, the adaptability of smaller drop pipes. Even semi-flexible tubing may possibly be employed if necessary.

Other features are the absence of objectionable motor hum; the efficient water-cooled motor operating in a sealed oil bath, requiring no change, and but negligible oil replenishing through a small tube run to the surface; absence of pump house; no fear of motor damage from fire or flood; simplicity of installation.

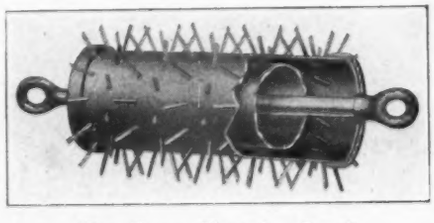
For an illustrated bulletin descriptive of the unique "Submersible," write Byron-Jackson Co., Los Angeles, California, or 420 Lexington Ave., New York.

▼

Hercules Sewer Brush

A sewer cleaning tool that actually scours, is amongst the newest additions to the line of sewer cleaning equipment offered by Turbine Sewer Machine Co., long and well known in the sewerage field.

This gadget literally "bristles" with effectiveness because its projecting quills are of high tempered steel, galvanized for protection against corrosion. (We have christened this new sewer-brush *"The Porcupine"*). Beyond this, the picture tells the story of the bristle tight (double-cylinder) construction, and the hefty double eye-bolt which holds it together and serves as cable pull-eyes. The U-shaped easily renewed bristle tufts, diagonally set for enhanced scarifying effect and tightness, are a feature. They are clipped short enough to exert positive spring action, and wire brush effect, without sticking.



The Turco Hercules Brush

These "Turco-Hercules" Brushes are uniformly 9¾ inches long, but come in individual sizes for 6 to 18 inch sewers. With its use all obstructions, such as roots and encrustations and slime (on side and top and bottom of the pipe), are removed to expose the original smooth surface. Thereby, the initial capacity and free-flow of the line is recovered.

For further details, and descriptive leaflet, write Turbine Sewer Machine Co., Milwaukee, Wisc.,—or, (in the East) Turbine Sewer Machine Corp., 109 Crosby St., New York City.

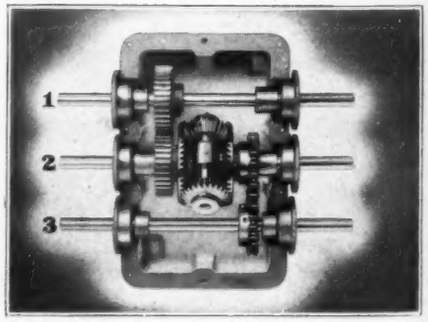
▼

Reeves Differential Control

A new differential control mechanism has been developed by Reeves Pulley Co., of Columbus, Ind., as an added accessory for use with the Reeves Variable Speed Transmission.

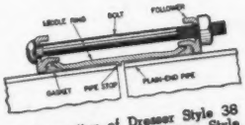
The new unit, which is similar in principle to the differential in a motor car, has been developed for obtaining synchronization of two or more machines or parts of a single machine. In addition, a variety of requirements in automatic and uniform speed control can be attained with it.

Gears of 1:1 (stock) ratio drive, in oil, between shaft No. 1 and the differential gearing which, in turn, has a 1:1 ratio chain drive connection to shaft No. 3 (see illustration). For automatic control service, shafts 1 and 3 are connected to the driven machine, or machines. Shaft 2 is connected to the speed changing screw of a standard Reeves Transmission. When shafts 1 and 3 are driven in the same direction, and at like speeds, shaft 2 stands still. Then, as quickly as the speed of the driven machine varies above or below the desired speed, the variation is transmitted through the differential to



Differential with Top Removed

WASHINGTON *O-K's them also!*



Cross section of Dresser Style 38 Steel Coupling for steel pipe. Style 53 Cast Coupling is the same, except of cast material for cast-iron pipe.

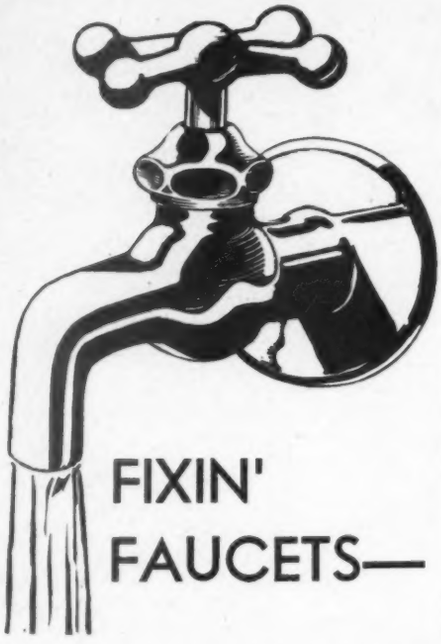
Here are five major reasons why Dresser Couplings are the *practical* answer to your joint problems on sewage lines: (1) Permanent Tightness; (2) Flexibility; (3) Simplicity; (4) Strength; (5) *True* Economy. • Before you install your next air, water, sludge, or outfall line, *learn* MORE about these Dresser advantages. Write today for our 172-page General Catalog No. 36—actually a valuable handbook on pipe joints! S. R. DRESSER MFG. COMPANY, BRADFORD, PA.

In Canada: Dresser Mfg. Company, Ltd., 60 Front St., W., Toronto, Ont.

(*Above*) Installing Dresser Couplings on discharge line from raw-sewage pump . . . one of three such lines (48", 42" and 36") at the Blue Plains sewage-treatment plant, Washington, D. C.

(*Right*) 10" cast-iron water line joined with Style 53 Cast Couplings and supplying fresh water to the Washington sewage plant.

% CHEMICAL FEEDERS %



FIXIN' FAUCETS—

The millions of faucets supplied by the big water companies have all been fixed! The large companies could afford the considerable first cost of chlorination and couldn't afford to take a gamble on plague darkening their reputations.

But there are still millions of unsafe faucets periodically dispensing a possible typhoid contagion or other water-born disease. These are the responsibility of the smaller water companies, quasi-public water supplies, and private water system owners.

No longer can the argument of "too high first cost of chlorination" excuse those whose water faucets aren't fixed.

Hypo-chlorination does not cost much to install or to operate. %Proportioneers% Chlor-O-Feeders dependably insure against water contamination.

Ask for our bulletin on the Little Red Pump.

We would like to help you—
FIX YOUR FAUCETS!

% **PROPORTIONEERS** %
Inc.

Associated with Builders Iron Foundry

9 N. Codding Street

PROVIDENCE, R. I.

shaft 2, which speeds up or slows down the Transmission unit until synchronous speed is restored.

It can also be readily seen that an infinite range of speed variations may be secured by connecting shaft No. 1 to the constant speed shaft and No. 3 to the variable speed shaft of a Reeves Transmission. By turning the speed control hand-wheel on the Transmission, shaft No. 2 may be adjusted from zero r.p.m, to any desired speed in either direction. The new Differential may also be used as primary driving equipment. And, it may be used to control index and register, either manually or with photo-electric equipment.

The new unit, known as Model MDB—3, measures 8 x 11 x 6⅝ inches.

For literature more adequately describing the Differential, and its adaptations in controlled speed operation, write Reeves Pulley Co., Columbus, Indiana.

▼

Massey Becomes A.G.P.'s General Sales Manager

Harold Massey

Harold Massey, young, capable, energetic sales engineer with American Gas Products Corp., has just been made its General Sales Manager,— such being recently announced by Wm. T. Rasch, President of A. G. P.

Mr. Massey, a graduate of Steven's Tech., entered the gas industry in 1923. Since 1930 he has been connected, first with the American Radiator Co. as designer of gas appliances and, later, transferred to American Gas Products as sales engineer. In 1936 he was made assistant sales manager under H. H. Dugdale, vice president in charge of sales. The recent death of Mr. Dugdale left vacant the position to which Mr. Massey has been appointed. Another instance of America's method of recognizing and rewarding ability.

Wanted: A nationally known company desires to find a man of the sales executive type who has had at least ten years' experience in the selling and handling of sales of Cast Iron Pipe who feels himself capable of introducing a new product successfully. Give full particulars, stating age, education, experience, and references, in replying to this advertisement. Box No. 501, Water Works and Sewerage, 400 W. Madison St., Chicago, Ill.

USED TRENCHER

P&H ladder type, in excellent condition. Digs from 22" to 34" trench, up to 13' deep. Priced for quick sale at only $3,400.00. Also available on rental basis. Address—Box 517. WATER WORKS AND SEWERAGE, 400 W. Madison St., Chicago, Ill.

Announcing
The New **EVERSON**
Type "R" Chlorine Sterilizer

HERE at last is the perfect chlorine sterilizer featuring the exclusive EVERSON *micro-control,* absolutely accurate feature, combined with the other proven EVERSON features including: Automatic Gas Absorber, Automatic Venting, and the Automatic Vacuum Break which protects against Back-Flooding.

EVERSON can supply capacities for every need—from small water works and swimming pools, to large sewage treatment plants.

Write for New Bulletin

EVERSON MFG. CO.
"The Swimming Pool People"
233 W. Huron St., Chicago, U. S. A.

COPPERAS
(FERROUS SULPHATE)
• • • FOR WATER & SEWAGE TREATMENT
(The Base For Chlorinated Copperas)

WATER TREATMENT

Summarizing the experiences with Chlorinated-Copperas in a large city another well-known and proficient manager* states in a published article* the following conclusions:

1—That it is an excellent cold water coagulant.

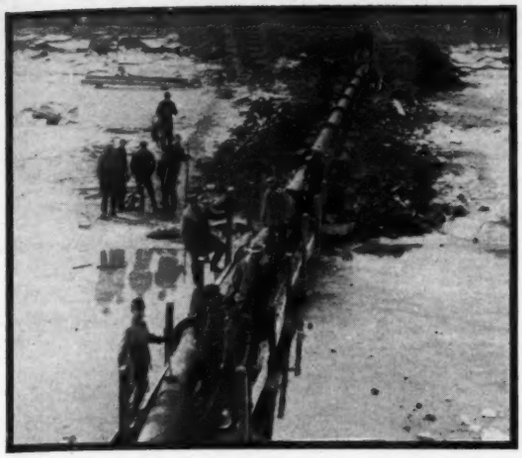
2—That it has reduced operating costs.

3—That it produces benefits, with no unfavorable results.

WE INVITE YOUR INQUIRIES

*(References to articles and authors' names available upon request)

FAESY & BESTHOFF, INC.
22 E. 40th St. New York



CROSSING BLUE RIVER, KANSAS CITY, WITH 16" MOLOX BALL-JOINT PIPE

THIS booster line for Leeds, Mo., operates at 90 to 100 lbs. pressure. Crossing of Blue River, as shown in accompanying photo, was made with 16" Molox Ball-Joint Cast Iron Pipe at a time when the river was very low, having approximately 2 ft. of ice and 8 ft. of water. Acipco has the answer for pipe line stream-crossing problems. Write for detailed literature.

AMERICAN CAST IRON PIPE COMPANY
BIRMINGHAM, ALA.

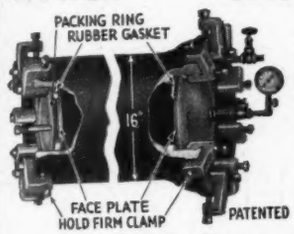
New York City Chicago Kansas City Minneapolis Dallas
Los Angeles San Francisco Pittsburgh Cleveland

"HOLD FIRM"

A NEW TEST PLUG

For Testing Mains Conveying

WATER GAS OIL AIR



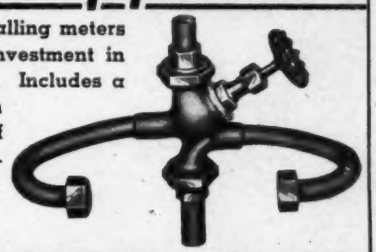
For testing cast iron, steel, transite, soil and concrete pipe lines, without the necessity of valves; test pipe as you lay them; eliminate open trench and hazards; special for testing reclaimed pipe, valves and fittings. Installed by any unskilled laborer; withstands 300 lbs. hydrostatic pressure, light in weight; same clamps fit many sizes of pipe. Made in all sizes. Used by the City of Chicago, contractors and municipalities.

Send for Circular and Complete Information

TEST PLUG MFG. CO. (not inc.) NILES CENTER, ILL.

The Valve Copperhorn

The ideal fitting for installing meters in basements. A real investment in service and satisfaction. Includes a high grade compression valve for shutting off back water and for customer convenience.



Write for catalog.

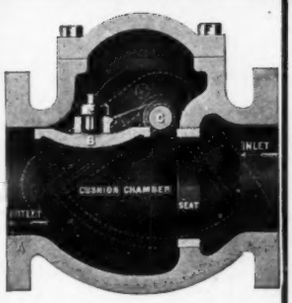
THE FORD METER BOX CO.
WABASH, INDIANA, U. S. A.
SETTING AND TESTING EQUIPMENT FOR WATER METERS

GOLDEN-ANDERSON VALVES

Mean
Satisfaction-Economy-Durability

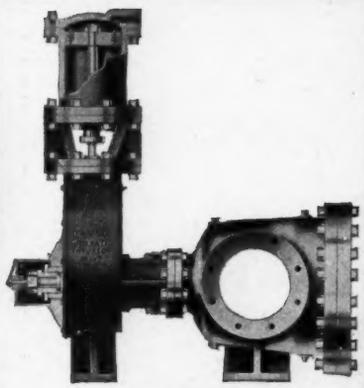
Altitude Control — Automatic, air and water cushioned. These Valves will hold water in elevated storage at exact predetermined level. No floats, long connections or complicated fixtures needed. Operation is by static head. Places control in accessible position, and is unfailing in operation.

For more than 30 years Manufacturers of Valves.



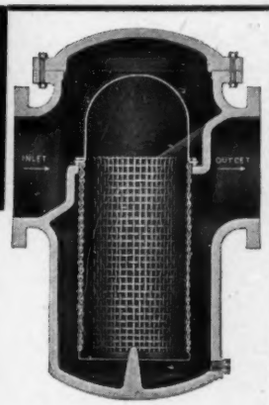
Cushioned Check Valve

The balanced design and full area reduces water pumping costs 75%. Thoroughly cushioned to overcome water hammer or shock. May be furnished with hand lever control.



Thru-Flow Cone Valves

Valve is always unseated axially, rotated without rub or friction and reseated axially in either position; all in one operating movement and drop tight in both open and closed positions. Furnished in sizes 6 to 72 inches.



Water Strainer

The most efficient strainer for insuring clean water for water works, railroads, industrial plants and processing service. Easy to clean and with large area. Heavy and extra heavy types.

Our engineers are at your service. They may be able to effect a definite saving for you in your valve installations.

GOLDEN-ANDERSON VALVE SPECIALTY CO.
1329 FULTON BLDG. PITTSBURGH, PA.

As if it were a guardian to the people living below, the water tower stands on the hill overlooking the city. From it pure, clean water flows down through pipes and out of water taps in homes. And without question, people drink this water every day, year in and year out.

Plagues seldom terrorize communities and cities nowadays. Health authorities everywhere have long since recognized the true value of water chlorination in relation to plagues. Modern water purification plants in charge of competent engineers, chemists and water-works men are standard equipment of nearly every state, city or township in the country.

Solvay's "Big 3" Service is a service system that insures *quick* and *adequate* supplies of Liquid Chlorine to state and municipal water purification plants. It is a service on which water-works men can always depend for Liquid Chlorine supply . . . *and* for advice and technical assistance when required.

Solvay Liquid Chlorine shipments are now routed from Syracuse, New York, and Hopewell, Virginia. Upon announcement during the early part of 1938 shipments will be made from the new Baton Rouge, Louisiana, Liquid Chlorine plant. Your inquiries on Solvay Liquid Chlorine are cordially solicited. Write to your nearest branch office listed below or to

SOLVAY SALES CORPORATION

Alkalies and Chemical Products Manufactured by The Solvay Process Company

40 RECTOR STREET **NEW YORK**

BRANCH SALES OFFICES:

Boston, Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Indianapolis, Kansas City, New Orleans, New York, Philadelphia, Pittsburgh, St. Louis, Syracuse

SOLVAY

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LIQUID CHLORINE

MEETINGS SCHEDULED:

Nov. 15—NEW YORK CITY (Engineering Societies Building). **American Society of Mechanical Engineers.** Special symposium—"Sewage Pumps and Pumping." Leading pump engineers participating. In charge—William Raisch, Cons. Engr., 227 Fulton St., New York City.

Dec. 29—NEW YORK CITY, N. Y. (Hotel New Yorker). **New York Section & New Jersey Section A. W. W. A.** Joint "Get-Together" Luncheon followed by meeting. Sec'y, R. K. Blanchard, 50 W. 50th St., New York City.

Jan. 17-21—STILLWATER, OKLA. (A. & M. College). **Oklahoma Water & Sewage Conference** (Water & Sewage Short Course). Sec'y of Conference, J. H. Darcey, State Dept. Health, Oklahoma City. Head of Short Course, Prof. E. R. Stapley, A. & M. College, Stillwater, Okla.

March 17-18—JAMESTOWN, N. Y. (Hotel Jamestown). **New York Section A. W. W. A.** Sec'y, R. K. Blanchard, 50 W. 50th St., New York City.

March 23-25—WINDSOR, ONTARIO (Prince Edward Hotel). **Canadian Section A. W. W. A.** (Annual Meeting). Sec'y-Treas., A. E. Berry, Ontario Department Health, Parliament Bldgs., Toronto, Ont.

March 28-April 1—OCALA, FLA. (Camp Roosevelt). **Florida Section A. W. W. A.** Sec'y, J. R. Hoy, 404 Hildebrant Bldg., Jacksonville, Fla.

April 7-8—LAFAYETTE, IND. (Purdue University). **Indiana Section A. W. W. A.** (Annual Meeting). Sec'y-Treas., John A. Bruhn, Indianapolis Water Co., 113 Monument Circle, Indianapolis, Ind.

April 24-28—NEW ORLEANS, LA. (Hotel Roosevelt). **American Water Works Association.** (Annual Convention). Executive Sec'y, H. E. Jordan, 29 W. 39th St., New York City.

CATAOGS AND LITERATURE RECEIVED

[*Any of the publications reviewed in this section can be secured from or through Water Works and Sewerage, if such be desirable.*]

"Paved Sewer Pipe"—From Armco Culvert Manufacturers Association, has come a handsomely done brochure. It is a veritable handbook on economical sewer construction with the Armco Corrugated Pipe, galvanized against corrosion and supplied with the wear resisting paved invert of asbestos bonded bitumen. Stressed are such attributes as strength with flexibility; resistance to corrosion and explosion damage; root-proof and leak-less jointing, in or out. Fittings and manhole construction are covered in illustrated manner and the all-important consideration—"Construction Costs"—are weighed by analysis and comparisons. Then, follow tables of general design and installation data and suggestive construction methods of sub-grade and elevated sewers. "What Size and Slope Sewer"? constitutes another important discussion, amplified by useful discharge head-loss and capacity charts. And at the end are the specifications for "Asbestos Bonded Armco Sewer Pipe." It's a worthy production: interesting, revealing and serviceable. For a copy, write Armco Culvert Manufacturers Association, Middletown, Ohio.

"Construction Service"—Comes from Pittsburgh-DesMoines Steel Co., a copiously picturized presentation of this company's varied construction service activities

in the field of water, sewage, gas, incineration, swimming-pools, irrigation, bridge building, aeronautics, industrial construction. Especially interesting to our readers are the typical projects, pictured with explanatory captions, such as filtration plants, pressure sludge-gas holders, sewage treatment plants, incinerators, elevated tanks, storage bins, dams, pipe lines—in fact, complete water works systems. To look over Bulletin 602 is to realize the extent of "Construction Service" offered by Pittsburgh-DesMoines Steel—since 1893. For a copy, address the company—Neville Island, Pittsburgh, Pennsylvania.

"Ross—Valves and Specialties" — In the water works field, for 58 years, the name Ross of Troy, N. Y., has been associated with dependable specialty equipment —notably altitude, pressure reducing and control valves surge relief valves, hydraulic pressure-boosting pumps (hydraulic rams in reverse), and other equipment too numerous to list. The years of progress are shown, now, in the complete catalog of Ross Hydraulic Equipment just issued. One of the latest additions to the Ross line —the Dual-Seated Throat Valve for water and sewage systems, is pictured and described. Fully illustrated, there are 71 pages of Ross "Trojan" equipment described, and replacement parts listed, in the new Catalog —37. For a copy, write Ross Valve Mfg. Co., Troy, New York.

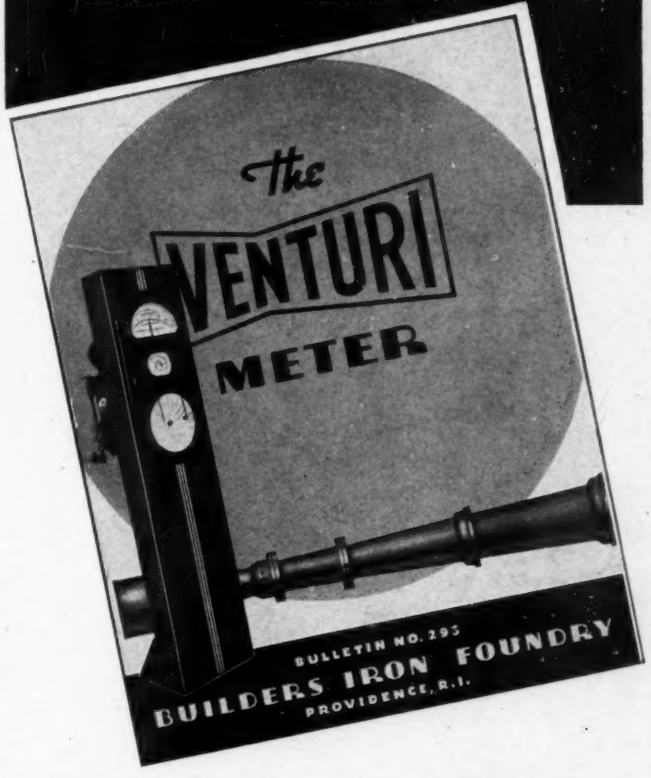
"Aluminum Paint Manual"—As the caption signifies, is a comprehensive 100 page manual on the characteristics, selection and application of Aluminum Paint. Its contents have been derived from many years of experience in practical use of aluminum paint and extensive investigations of Aluminum Company of America's research laboratories. Thoroughly indexed for ready reference and informatively illustrated, are the chapters. "Characteristics," "Vehicles for Aluminum Paste or Powder," "Methods of Mixing and Application" (spray, brush, dip, etc.), "Directions for Use on Various Materials and Surfaces" (wood, steel, concrete, brick, bituminous surfaces, pipes et al), "Specifications for Aluminum Paint Vehicles." A sample-coupon chart shows the finishes obtainable with the several grades of Alcoa Pigments, in varnish and lacquer. The new Manual contains essentially all that should be known about Aluminum Paints and their application. It is worthy. For a copy, write Aluminum Company of America, Pittsburgh, Pa.

"The Champion"—Is presented in Champion Corporation's bulletin covering the "O.K." Champion Power Sewer Cleaner which has established records for low cost sewer cleaning. In addition to Champion's No. 1 Cleaner for larger cities, less expensive manually-operated models are illustrated and described. For the smaller systems, the "O.K." Champion Junior is offered. Pictured also are sewer-rods, turbine cleaning heads and other cleaning appurtenances. The newest equipment in service on the Atlantic City Sewerage Company's system is pictured and a challenge is thrown out to operators, to match a cost of less than 3/100ths of a cent per foot for sewer cleaning. For the Champion folder and a catalog, write Champion Corporation, Hammond Indiana.

"Hypo-Chlorination"—Has recently appeared in its 76-page 3rd edition. Written by W. A. Savell, Manager, Technical Service, it is published and distributed by Mathieson Alkali Works, Inc. Written around Mathieson's dry hypochlorite HTH—"Hypo-Chlorination" tells

Bulletin 293

NOW READY



WATER WORKS and SEWAGE PLANT Designers and Superintendents will be interested in Bulletin 293, which contains up-to-the-minute information regarding Venturi Meters. (A companion bulletin to No. 287, "Measurement, Control and Chemical Treatment of Sewage and Sludge).

Of especial interest:

The illustrations and descriptions of the *new* Type M Register-Indicator-Recorders (Model D and Model F).

The discussion of the Chronoflo Meter as used in summing up the total flow of many different instruments.

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of the many adaptations of this concentrated carrier of available chlorine in water works and sewerage routine operations and emergencies. Sterilization of Mains, Algae Control, Cleansing and Sterilization of Filter Beds, Well Sterilization, Swimming Pool Application, are but a few uses covered. A quick reference table reveals conditions which may be remedied by chlorination, methods found practical, and points of application. There are "Solution Strength" and "Dosage Computing" tables. The closing section is devoted to an illustrated presentation of the array of "Typical Dry Feeders and Solution Feeders" available on the market today. At the end are specifications covering HTH., and illustrated styles of packages available. For a copy of "Hypo-Chlorination," write Mathieson Alkali Works, Inc., 60 East 42nd St., New York City.

"The Little Red Pump"—Is the subject of Bulletin RED just issued by %Proportioneers, Inc.% (Builders Iron Foundry Associate), which represents the up-to-the-minute and most complete bulletin covering the entire line of fixed and proportioning solution chemical-feed equipment for stationary or portable use in "Hypo-Chlorination," coagulation, pH adjustment of portable water, sewage, boiler water, pool-water treatment. Many pictures illustrate the various "Tret-O-Unit" models, and the numerous actual working installations of "The Little Red Pump," for various duties in large and small systems. For Bulletin "RED," write %Proportioneers, Inc.%, 9 Codding St., Providence, R. I.

"Saunders' Patent Valves"—The rugged, unique, corrosion-proof Saunders Patent Diaphragm Valves are presented in recent leaflets from Hills-McCanna Co. of Chicago. The operation of these valves is as simple as stepping on a rubber hose to stop solution flow. The closing-stem presses down a tough resilient reinforced diaphragm on a ridge-hump, just as one would clamp a hose closed. The liquid does not reach the closing stem. Good for pressures to 125 lbs. and temperatures to 180 deg. F., these valves have many corrosion and trouble-free uses. Simplicity and ease of diaphragm replacement (in place) are other distinctive features. On chemical feed lines they are especially worthy. For "Saunders' Patent Valves," write Hills-McCanna Co., 2349 Nelson St., Chicago, Ill.

"The Venturi Meter"—Is a new bulletin from Builders Iron Foundry (founded 1891), which presents the fundamentals of Venturi tubes and various types of installation. The newest (Type M) B.I.F., Model D-Register, Indicator, Recorder, improved mechanically, dignified and beautified, is described by word, drawings and pictures. And the "Long Distance Chronoflo" meter comes in for its deserved share of description and illustrated explanation of adaptability and installation. Some pointers, in trouble elimination and installation of Venturi tubes, are given as an aid to designers and operators. The new bulletin (No. 293) can be had by writing Builders Iron Foundry, 9 Codding St., Providence, R. I.

"Fairbanks-Morse Printomatic Scales"—Describes the features of Fairbanks-Morse Springless Dial Scales, equipped with automatic weight recording (printing) attachment, to provide an undisputable and permanent record of weight. Similar scales have been installed at treatment plants for checking chlorine feeds accurately, and for eliminating the "human element" and arguments. Address, Fairbanks-Morse & Co., Chicago, Ill.

"Worthington Turbine Pumps"—In a folder from "Worthington" of New Jersey is pictured a typical sec-

tion through a well, the motor, and a Worthington Deep Well Turbine, reproduced in colors to emphasize materials of construction and operating features. Beyond, are pictured various styles of drive heads including the combination motor-engine drive head, now increasing in popularity. For a copy of Bulletin W-450-1327, write Worthington Pump & Machinery Corp., Harrison, N. J.

Gas Holders:—From Koppers Company (Western Gas Division) Fort Wayne, Ind., has come two bulletins descriptive of "Western Gas" Low Pressure Gas Holders and "Western Gas" High Pressure Gas Holders now being offered in the sewerage field for service in sludge gas storage and utilization. Complete dimensions and working capacities are given for each style. For the reference and design file these two condensed bulletins are worthy of note. Ask for Koppers' "Western Gas" Bulletins 313 and 314. Address Koppers Company, Fort Wayne, Ind.

"Sullivan Plus Portable Compressors"—Is a 24-page bulletin from Sullivan Machinery Company, presenting their complete line of two-stage portable air compressors and accessories. It is profusely illustrated, in respect to equipment units and their application in drilling, pavement cutting, operating hoisting drums and hauling lines in field construction. An imposing list of users, from around the world, is a reflection of the effective service coverage which this 80 year old compressor manufacturer boasts. Many portable models are pictured and described by specification, the smallest being mounted on a two-wheel trailer. For a copy of "Plus Portable Compressors," address Sullivan Machinery Co., Michigan City, Ind., or Claremont, N. H.

"Lindewelding Pipe Lines"—Is a 32-page booklet from Linde Air Products Company. It discusses and picturizes an improved welding method used in constructing more than 5,000 miles of pipe lines. Stressed are the claims for economy and rapidity of construction (by Lindewelding), simplicity of field operations, strength of welds. Welding specifications are set forth and the advantages of the various methods are discussed, including the newer "all-bell-hole" method. For a copy of "Lindewelding Pipe," address Linde, 30 East 42nd St., New York City.

"Omega Gravametric Feeder"—Is a new bulletin describing Omega Machine Company's improved model of dry chemical feeder which controls by weight rather than volume of material fed. Available in two sizes (No. 1—10 to 2,000 lbs./hr.; No. 2—50 to 5,000 lbs./hr.). These machines require no calibration, Omega Shadow Control being featured. Full specifications are presented. Address, Omega Machine Company, 4010 Penn Ave., Kansas City, Mo.

"Water Well Supplies"—A complete 84 page catalog comes from the A. D. Cook Co., long known specialists in well construction, maintenance, operation, supplies. Their maxim is "Everything for the Well" and that applies to their new and effectively illustrated catalog, which carries an index starting with "Air Data" and ending with "Working Barrels." All inclusive, are the many types of Strainers, Points, Working Barrels, Seals, Rods, Leathers and a comprehensive line of drilling and developing tools. For practically all conditions, the new catalog No. 320 offers a complete selection for drillers and operators. At the end is a section on "Useful Data." For a copy of Catalog 320, address A. D. Cook, Inc., Lawrenceburg, Ind.

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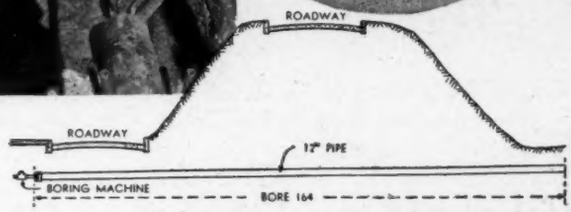

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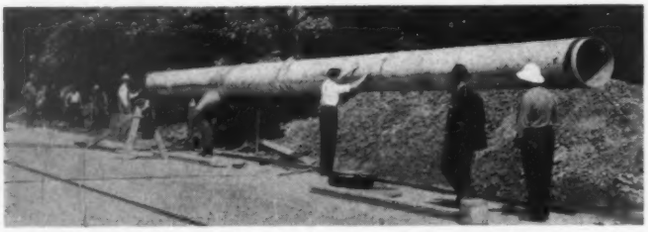

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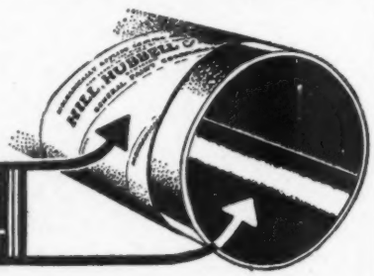

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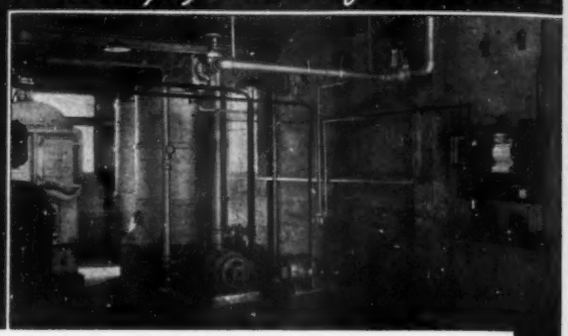

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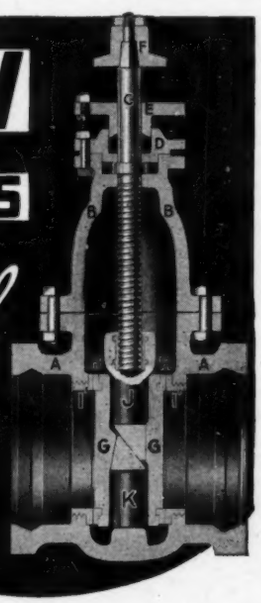

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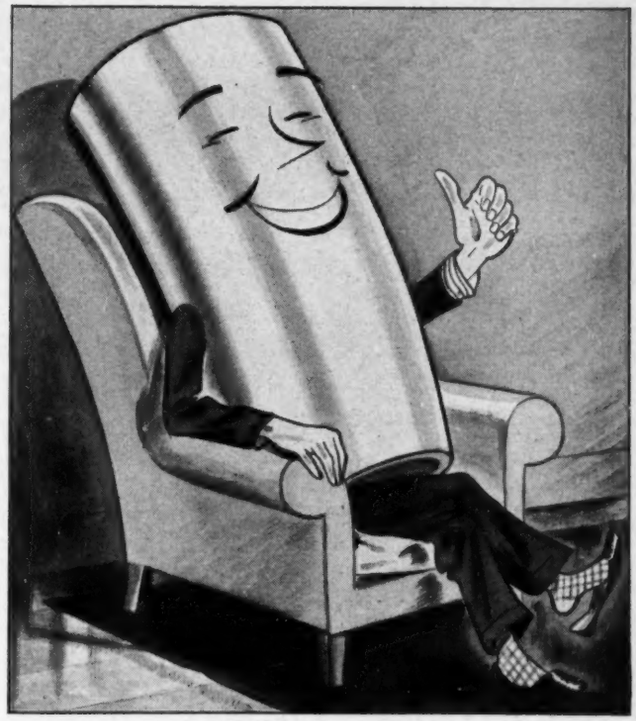

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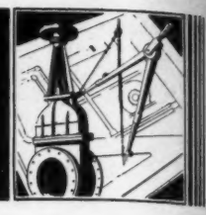

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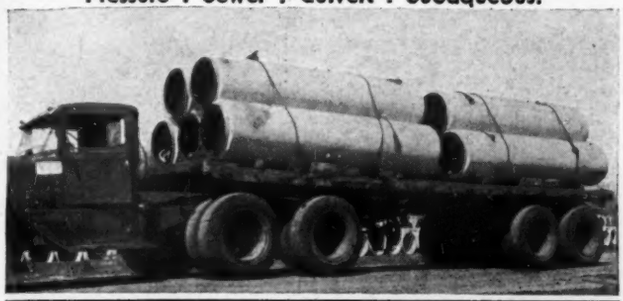

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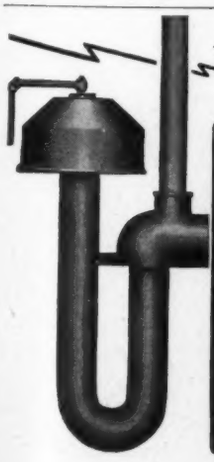

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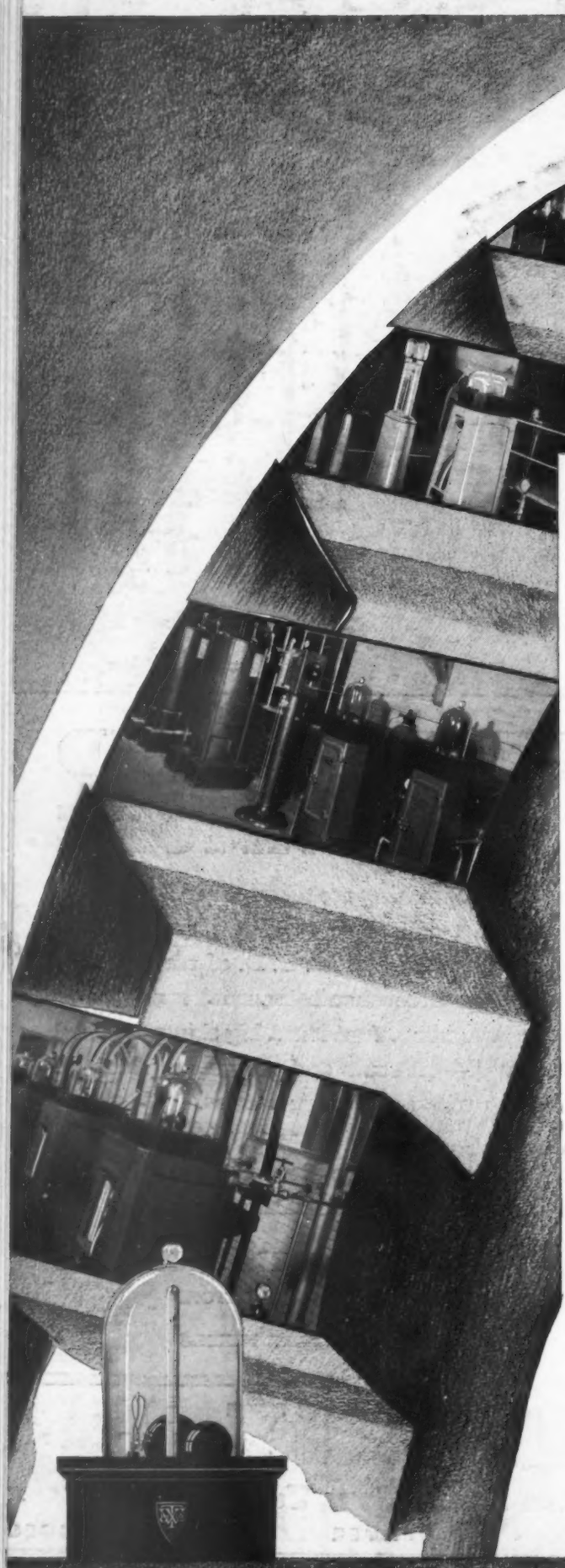

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